THE

ELECTRICAL REVIEW.

VOL. XLVIII. JUNE 21, 1901. No. 1,230.

CONTENTS:

	PAGE
Municipal Electrical Engineers at Glasgow	1045
On Mr. Edison's New Accumulator (*illustrated*)	1047
Notes on Meter Testing	1047
An Improved Method of Applying the Insulation Overlap Test (*illustrated*)	1048
Legal	1049
Parliamentary Committees	1050
Electric Power Distribution on Tyneside	1055
Correspondence:—	
The Musical Arc	1055
Sedneff Cells	1056
Inexpensive Mirror Galvanometers	1056
Fuel and Smoke	1056
Management of Accumulators	1056
The Three-Wire System for Tramway Supply	1057
Business Notes	1057
The Kensington and the Notting Hill Companies' Joint Electricity Works (*illustrated*)	1064
Supply Station Accounts	1074
City Notes	1075
Traffic Receipts	1076
Stocks and Shares	1076
Share List of Electrical Companies	1077
Market Quotations	1078
Institution of Electrical Engineers:—	
Storage Batteries in Electric Power Stations, Controlled by Reversible Boosters (*illustrated*) (*continued*) ...	1079
Physical Society	1081
Industrial Development	1081
200-H.P. Clarkson Oil Burner (*illustrated*)	1082
Changing Over	1082
Street Lighting	1083
Snow Clearance	1085
Current Specifications.—LXVII.	1086
New Patents	1087
Abstracts of Published Specifications	1037

THE

UNIVERSAL ELECTRICAL DIRECTORY

1901 Edition

NOW READY.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.
Telephone No. 933 Holborn.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades,
AND HAS
BY FAR THE LARGEST CIRCULATION
of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—In Great Britain, Post Free per Year, 19s. 6d. To all other countries, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can now be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. Paris: VEUVE J. BOYVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13 Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

MUNICIPAL ELECTRICAL ENGINEERS AT GLASGOW.

ON Wednesday morning the representatives of the principal municipal electrical undertakings throughout the United Kingdom opened their four days' convention at Glasgow under the very fitting and able presidency of Mr. W. A. Chamen, the chief electrical engineer of the Glasgow Corporation.

No more suitable city than Glasgow could have been selected for this convention, for besides the fact that it is the meeting place for all engineers this year, it possesses an exceptional interest for municipal officials who are in any way connected with electrical development, by reason of the fact that it has long earned the title of "the model city."

Those who have taken advantage of the opportunities which have been afforded them of visiting the several large electric generating stations from which the city takes its lighting and power supply, and have investigated the extensive network of electric trolley lines, together with the great power house at Pinkston from which energy is obtained for working them, must have been convinced of the progress which the work has made in spite of the fact that municipal trading has been the controlling principle.

Whether these undertakings may be regarded as profitable in the commercial sense of the term, or otherwise, is a controversy, into the merits of which we need not enter in detail here, having on recent occasions expressed our views thereanent. No doubt municipal engineers are fully aware of the fact that Glasgow at the end of the eighth year of its trading realised a balance of £39 14s. 7d., with the following remark in the "Report by the Committee on Electricity to the Corporation of Glasgow for the year ending May 31st, 1900":—

"The Committee regret that, owing to the large amount which has had to be paid as interest on money borrowed for new works during the past year, which are as yet unproductive, it has not been found possible to write off in the account now submitted so large an amount in respect of depreciation as was written off in the previous year."

If the example of Glasgow were followed in every town, and a fair amount applied for depreciation and renewal of plant, how many instances would be found of any real financial success in municipal trading in electricity? Would it not indeed be proved to demonstration that it is a fallacy?

The municipal electrical engineer is a municipal electrical engineer because the position furnishes his means of subsistence, not of necessity because he is a supporter of the doctrine of municipal trading. In this connection it is exceedingly interesting at the moment to draw attention to the fact that three past-presidents of the Municipal Electrical Association are no longer occupying positions as city electrical engineers acting in subservience to the whims and fancies of one particular Council or Corporation. They

have elected to launch into wider fields where their former annoyances and obstructions will no longer be experienced, or at any rate, not in the same degree. We refer, of course, to Mr. C. H. Wordingham, Mr. A. H. Gibbings, and Mr. Arthur Wright, men whose past achievements in municipal work need no further reiteration at this stage.

They, and most municipal electrical engineers, must be fully alive to the fact which we have emphasised in these columns over and over again, that municipal electric supply as at present carried on can be but temporary, and in a measure it will have to give way before long-distance transmission schemes which have large generating stations at centres controlling the supply of electricity for many hundreds of square miles. Great as have been the achievements of Glasgow, Edinburgh, and some other cities, we are convinced that in comparison with what *might* have been, and what now *is* to be, they are small. Freed from the narrow confines of municipalisation, the business of electrical supply will now go forward with unparallelled progress. What is the position of the borough electrical engineer in regard to this phase of the development? We do not believe that he has any immediate occasion to fear, for he will be a very necessary official for years to come, but it is as well that he should study seriously the bearing of the present successes of private enterprise upon the ultimate position of municipal electrical undertakings.

Mr. Chamen has devoted a great deal of attention recently to the question of charges for electrical energy, and in his presidential address on Wednesday, after indicating the progress which the Association had made in membership since last year's meeting, he went in detail into this subject, which is one calling for much anxious thought on the part of all municipal engineers and committees who wish their systems to be conducted on a satisfactory basis. His comments are deserving of study, and we shall deal with them more fully next week.

Electric Lamp-Posts in the Streets.

The case of Chaplin *v.* The Mayor, &c., of the City of Westminster, which was reported in our issue of last week, raised an interesting question relating to the erection of lamp-posts in that portion of the street which is best suited for the public needs, irrespective of the convenience of those whose premises adjoin the street. It appeared that the defendants' predecessors had erected an arc lamp-post on the footway outside the plaintiffs' cellar slide in Villiers Street. The plaintiffs alleged that if it remained in this position the post would seriously interfere with the loading and unloading of his vans, and he made the suggestion that instead of using the post, the defendants should attach the lamp by means of a bracket to the wall of the plaintiffs' house. To this the defendants refused to accede, and the action was brought to restrain them from allowing the post to remain. Mr. Justice Buckley refused to grant an injunction. He drew an elaborate distinction between "private" and "public" rights of using the highway, and said:—"The plaintiffs' rights are to use that portion of the highway for loading and unloading their goods in common with the other members of the public, and they cannot set up their private right against the defendants to prevent them obstructing the highway by the erection of lamps. I agree that the defendants must not use their powers so as to create a nuisance, but I think they may, for the benefit of all members of the public, affect to some extent the convenience of one of the members, and that is all it can be said they are doing in this case." He gave judgment for the defendants. In view of the above clear statement of the law, it is difficult to see how the plaintiff could have succeeded. Were every householder entitled to object to the erection of a lamp-post in front of his door, the lighting authority would have a task of some difficulty in selecting sites which could not be objected to. It seems to follow that such companies have power to some extent to do that which, although not a nuisance in law, may be a nuisance in fact. In the case of Goldberg *v.* the Liverpool Corporation, which was heard last year, the plaintiffs objected to the erection of a pole and fuse box outside their premises, and sought an order for their removal, which was granted by the Vice-Chancellor of the County Palatine Court of Lancaster. The Court of Appeal overruled this decision, saying:—(1) That the Corporation in erecting the pole and fuse box were acting within their statutory powers; (2) that they had clearly exercised those powers *bonâ fide* for the purposes for which they were conferred. "But for the Act," said the Master of the Rolls, "no doubt the plaintiffs could have maintained an action for nuisance. But the Act authorised a nuisance, and unless the plaintiffs can prove that the powers conferred by the Act have been abused, they have no remedy. . . . The Court cannot go into the question as to what is the most convenient situation for a pole. If they did that they would have to lay down the tramway themselves." The numerous cases which have recently come before the Court in connection with the noise and vibration caused at electric lighting stations serve to show that although a lighting company may be bound to supply electricity, no nuisance or interference with a private right can be permitted.

Secondary Batteries in Telegraph Work.—The *Western Electrician* says:—"Few persons realise the rapidity with which the primary battery is disappearing as a source of current in telegraphy. For 50 years this useful type of apparatus was relied upon to operate the telegraphs of the world, but within the last few years the dynamo has demonstrated its superiority for this work, and is now rapidly superseding the battery. The work of reconstructing the generating plants is proceeding in all the considerable centres of telegraphic work in this country, having been already accomplished in the cities of the first class, such as New York, Chicago, and St. Louis. Take the western division of the Western Union Telegraph Company, for instance. In Chicago and St. Louis the machines have been installed for some time, but in a number of smaller cities the change has been but recently made, or is now under way. In Cincinnati 13,000 gravity cells have just been replaced by 18 motor-dynamos. These machines are wound for 220 volts on the motor side, and for voltages ranging in different generators from 7 to 340 volts on the dynamo side. The machines of higher voltage are used for supplying the long quadruplex lines. Current is supplied from central station mains, care being taken to have other sources of supply in reserve in case of necessity. This is the practice followed in all the newer plants, which are installed under the direction of J. C. Barclay, of Chicago, the electrician for the company. Among other cities where the motor-dynamos have just been, or are now being, installed, are Cleveland, where 11,000 cells were replaced; San Francisco, 10,000; Denver, 9,000; Toledo, 5,000; Minneapolis, 5,000; Houston, 5,000; and Duluth, 3,000. Here, in eight cities, is a total of 61,000 cells of primary battery replaced by motor-dynamos within the last few months." It may be added, in this connection, that in all the large English telegraph offices secondary batteries are in service instead of the old primary cells.

ON MR. EDISON'S NEW ACCUMULATOR.

By W. HIBBERT.

It is evident that the practical monopoly of the "storage" function, which the lead accumulator has held for such a long time, is to be seriously challenged. Some months ago we heard of a new cell—the Jungner—devised by a Norwegian engineer, who uses an alkaline liquid with iron or nickel on the one hand, and silver on the other. No very decisive figures were obtainable about it, though the German patent was said to have been bought by Messrs. Siemens and Halske. Now we have a somewhat similar cell described by Dr. Kennelly. As Mr. Edison's invention, it is sure to command attention, and will elicit data for a rigorous comparison with the best acid cells of the present day. A preliminary discussion of the facts detailed by Dr. Kennelly may help to anticipate some of the points.

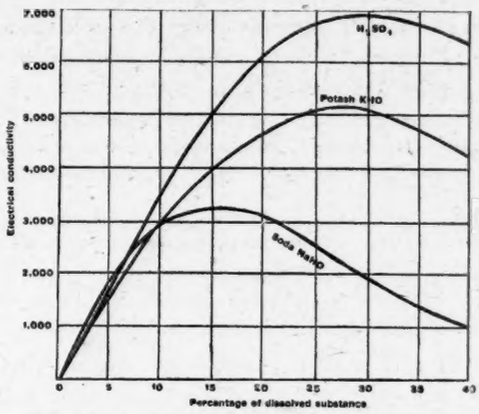
Many interesting questions arise from the substitution of alkali for acid. The adjoining curves exhibit the relative electric conductivity of potash, soda, and sulphuric acid.

There is no great difference between the specific conductivity of the acid and that of potash. Taking the strength of acid commonly used (28 per cent.), and the 20 per cent. of potassium hydroxide used by Mr. Edison, the relative conductivities are as 3 to 2—a ratio which will not exercise any special influence.

A greater difference arises from the fact that the alkali does not enter into chemical union with the active materials on either plate. There is practically no change of density during a cycle, unless overcharging—with consequent decomposition into gases—is indulged in. The hydrometer will be able to indicate the cumulative effect of this minute decomposition, but will presumably be unable to indicate the progress of a charge and discharge. The potential difference at terminals will in the new type become a more important revealer than in the old, and the characteristic curve of charge and discharge voltages will be required for all rates. It is curious that in this respect no information is contained in the published accounts. The initial potential difference after recent charge, we are told, is 1·5 volts, while the mean voltage of full discharge is approximately 1·1 volts. What is wanted is a continuous record, showing whether the P.D. falls off gradually, or whether (as in acid cells), it maintains a fairly high level for most of the discharge. The character of this curve will exercise great influence on all questions of regulation where constant potential difference is required. Not only so, it will largely determine the possible efficiency under the best conditions of working. The few figures given by Dr. Kennelly seem to indicate a maximum possible efficiency of $\frac{1\cdot1}{1\cdot5} = \cdot73$. Whether the discharge curve has been determined or not, does not appear; inquiry for it in the case of the Jungner cell failed to elicit definite information, and similar inquiry at the close of Dr. Kennelly's paper met with no better result.

It might be expected that the constancy of the alkali strength would do away with the diffusion problems that play so important a part in lead accumulators. But this does not follow. The constant content is true of the whole liquid, but it is not true of special parts. The electrolytic phenomenon known as the "migration of the ions," tends to set up local variations in density, and the reductions and oxidations at the electrodes will also act in the same way. It is not unlikely, therefore, that one of the functions of the thin flakes of graphite which Mr. Edison mixes with the oxides, &c., is to assist in minimising local variations in density. They are said to increase the conductivity of the briquettes, but this cannot refer exclusively to electric conduction.

Local Action.—The cell is said to be free from local action, the most insidious foe of the lead accumulator; but a very curious reason is added to account for this: "No local action occurs in the cell so far as has yet been observed, since the electromotive force is below that necessary to decompose water." It is to be hoped that the observation is more trustworthy than the reason. Zinc and copper, for example, do not give E.M.F. sufficient to decompose water, but they are quite competent to produce local action. It is not improbable that local action is absent or very small in these potash cells. Cubes of polished iron, which Faraday had sealed up in alkali, were seen by the writer 30 years after. They must have contained carbon, yet their surfaces were quite bright and apparently free from evidence of local action. But it is impossible to foresee how far local action



Curve showing Percentage Composition and Electric Conductivity.

will go in a particular case. So much depends on the exact nature of the conditions, that observation only can decide. Let it be noted, however that the excessively thin framework in which Edison sets his briquettes will enable a very small degree of local action to produce disintegration.

Probable Chemistry.—The active ingredients are nickel hyperoxide (represented by Dr. Kennelly as NiO_2), iron and potash. The chemical equation in its simplest form is—

$$\left.\begin{matrix}\text{After charge.}\\ NiO_2 \mid KHO \mid Fe\end{matrix}\right\} \text{ becomes } \left\{\begin{matrix}\text{After discharge.}\\ NiO \mid KHO \mid FeO\end{matrix}\right.$$

But this way of writing the equation is too simple, and has led to much misapprehension in the case of lead accumulators. It assumes that all the active material will be utilised in both charge and discharge, a desideratum which commercial conditions make impossible. The better way is to write the equation with undetermined coefficients, the numerical value of which can be found by subsequent analysis, thus:—

$$\left.\begin{matrix}\text{After charge.}\\ n\ NiO_2 \mid \begin{matrix}KHO\\ 12\ H_2O\end{matrix} \mid m\ Fe\end{matrix}\right\}$$

$$\text{becomes } \left\{\begin{matrix}\text{After discharge.}\\ \begin{matrix}(n-p)\ NiO_2\\ p\ NiO\end{matrix} \mid \begin{matrix}KHO\\ 12\ H_2O\end{matrix} \mid \begin{matrix}(m-q)\ Fe\\ q\ FeO.\end{matrix}\end{matrix}\right.$$

The values of n, m, p and q will vary with the discharge ampere-hours. The solution is here written KHO 12 H_2O, because that ratio of molecules gives almost exactly the 20 per cent. hydroxide used by Mr. Edison. In the degree in which the cell is overcharged (with consequent decomposition into gases), the 12 molecules of water will diminish, part being dissipated as oxygen and hydrogen.

NOTES ON METER TESTING.

By ARTHUR T. SMITH, A.M.I.E.E.

On May 3rd a few notes on meter testing were published in this journal, the methods used being chiefly applicable to the Hookham meters; it is my intention to supplement those notes by a few on the testing of a meter of a different type, that of an integrating wattmeter.

Many station engineers object to this type of meter owing to its continual consumption of energy in the shunt, and when this type is adopted the energy consumed in the shunt is required to be cut down as low as possible. This is quite right up to a certain point, but it should not be carried so far as to seriously reduce the torque, as meters with a low torque are easily affected by external causes such as dust or damp, but with a high turning moment a change in the friction of the meter will only alter the

accuracy to a slight extent. This class of meter is also subject to "creeping" on no load when it is fixed in a position where vibration exists. This may be entirely stopped in meters which have a retarding disc revolving between magnet poles, by fastening a small piece of iron wire on the periphery of the disc; this will simply hold the disc when on no load, but will not prevent the meter from starting on one lamp.

In the Thomson meter the commutator will sometimes be found blackened if working under somewhat adverse circumstances, and the usual practice was to repolish it by means of a thin strip of tape, and thus restore the meter to its original accuracy, but this need not now be done, as an adjustable starting coil has been provided by which means the accuracy of the meter may be restored without fear of its again altering.

Most meters of this class are so constructed that one revolution of the moving element is equal to one watt-second or some multiple of this.

The formula for testing may be stated as follows :—

$$\frac{3{,}600 \times \text{revolutions} \times \text{K}}{\text{Time in seconds}} = \text{watts} \qquad (a)$$

when K = constant of the meter, which, if not given, may be easily found by observation. For example, by counting the gear it may be found that the moving disc has a relation of 250 to 1—that is, 250 revolutions of the disc will register one unit on the dial.

From (*a*)—

$$\text{K} = \frac{\text{watt-seconds}}{3{,}600 \times \text{R}} \qquad (b)$$

Now 250 revs. = 1 unit

1 unit = 1,000 watt-hours

= 1,000 × 3,600 watt-seconds.

∴ 250 revs. = 1,000 × 3,600 watt-secs.

$$1 \text{ rev.} = \frac{1{,}000 \times 3{,}600}{250} = 14{,}400.$$

Substituting in (*b*) we have

$$\text{K} = \frac{14{,}400}{3{,}600} = 4.$$

In practice the formula (*a*) may be considerably simplified.

Putting watts = volts and amperes, we get

$$\frac{3{,}600}{\text{volts}} = \text{time} \frac{\text{amperes}}{\text{revs.} \times \text{K}}. \qquad (c)$$

By now taking a number of revolutions equal to the quotient of amperes divided by K, the latter term of the equation (*c*) reduces to unity, and we may regard our equation as

$$\text{Time} = \frac{3{,}600}{\text{volts}}. \qquad (d)$$

This is theoretically true if the meter is correct. An example will make the above clearer. A 440-volt Thomson meter of which the constant is 4, is put on test, and we pass 8 amperes through it; we must count two revolutions, and then the time of these two revolutions ought to be numerically equal to 3,600 divided by the noted volts. In practice I should advise 10 times the revolutions being taken, to reduce the error; this will only alter the decimal place.

3,600 divided by 440 = 8·2 (nearly).

At 440 volts, 8 amperes was passed through a meter and 20 revolutions counted, the time noted on the stop watch was 80 seconds; had the meter been correct, 82 seconds would have been the time registered, thus it will be seen that the meter is somewhat fast, as the time taken was less than the correct time. From this the percentage error may be deduced. By this means the tests are taken quickly, as it is only necessary to note the time recorded by the stop watch to ascertain if the meter be fast or slow.

A point which is often neglected in testing the above meters is the necessity of leaving the shunt on circuit some little time before testing, so as to bring its resistance to the true working value. What is necessary is to get the meter working under the same conditions as when on circuit in the consumer's premises, as it is useless taking a test on a meter when it is not running at the normal working temperature of the shunt.

In the 3-ampere KW.-hour type of the Thomson meter the test is quite simple, it being tested like an ordinary meter with no shunt. In these (220 volts) the armature should make 100 revolutions in 54·6 seconds with 660 watts applied.

AN IMPROVED METHOD OF APPLYING THE INSULATION OVERLAP TEST.

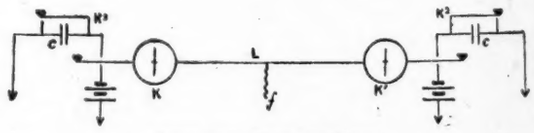
By WALTER BETTS.

THE old familiar insulation overlap method of localising a fault in a single cable appears to have been discarded chiefly on account of the difficulty of obtaining reliable results, owing to the variation of the resistance of the fault during the interval between the inter-dependent tests at the two ends. This defect was aggravated, to a great extent, by the manner of proceeding generally adopted.

The employment of the Wheatstone bridge seems to have been universal, and the arrangements invariably made for obtaining the two sets of inter-dependent observations were also defective—the common practice being for one testing station to take a series of tests from which the apparent best were selected or an indiscriminate average was made, to be calculated in combination with another average similarly established at the co-operating station. It is obvious that such observations can have only a chance and uncertain connection with each other, especially when the delay, disturbance, and difficulty experienced each time in balancing to a greatly and rapidly varying fault-resistance, or a changing earth-current, are taken into consideration.

Alternate single measurement is a step in advance, but little or no substantial advantage is gained so long as the delay and disturbance on the cable, caused by discharging, recharging, and re-balancing after each test, are not eliminated, and so long as the system of striking a mean of such readings is followed.

It is clear that only one *pair* of readings—composed of a single reading taken at each end—can bear any near or certain relation to each other, therefore no others can have a connective value in the calculations; in fact, they only depreciate those which are distinctly correlative.



INSULATION OVERLAP TEST.

By adopting the substitution method of measurement, and arranging so that the first observer shall take a reading at a given moment, then leave his end of the cable insulated, instead of allowing it to earth and discharge, so that the second observer shall be able to obtain a reading almost immediately afterwards, most of the above mentioned objections disappear and the remainder are minimised.

Let K press down his key at a suitable time and note the deflection at a prearranged moment (clocks being previously synchronised to a second or less), then instantly release his key. At the latter moment, K¹ will apply his current and take a reading as quickly as possible. The two results thus obtained form a distinct calculable pair, or set, and similar pairs can be repeated as often as desirable.

With synchronous timing, the small condenser C is not strictly necessary, but by causing a slight impulse on the respective galvanometers it has the advantage of enabling the operators at each station to see when the other applies or discontinues his current. The advantages of this method are :—

No equilibrium has to be obtained—often a very troublesome matter.

The instantaneous insulating by K, after his test, enables K^1 to obtain a reading without loss of time.

The galvanometer unsteadiness, fault disturbance, and necessity of recharging the cable—as caused by earthing instead of insulating—after each test being avoided, the complementary observation can be made with much greater rapidity and certainty.

The residue of K's current in *a* and *b* being free to escape only by way of the fault, tends to keep the latter constant (without further polarising it, owing to the momentary fall of potential on the disconnection of K's battery) until the current from K^1 comes into effect.

It is assumed that the fault would be approximately centralised by inserting resistance at the shorter end of the cable, and that due precautions with regard to the presence of earth current and reading to cable zero would be observed. For this purpose it would be convenient to connect by means of a key the terminals of the condensers, C (K^2).

LEGAL.

Bicknell *v.* Kalgoorlie Electric Power and Lighting Corporation, Limited.

In the King's Bench Division, on 12th inst., Mr. Justice Grantham and a special jury commenced the hearing of the case of Bicknell *v.* Kalgoorlie Electric Power and Lighting Corporation, Limited. It was an action by which plaintiff sought rectification of the defendant corporation's register by removing his name therefrom as holder of 850 £1 shares, on the ground of misrepresentation. Defendants denied misrepresentation, and counterclaimed in respect of money due on calls. Mr. Rufus Isaacs, K.C., and Mr. E. Clayton appeared for the plaintiff; and Mr. Lawson Walton, K.C., M.P., and Mr. J. W. McCarthy for the defendant company.

The plaintiff's case was that on September 4th, 1899, Mr. Wyman, one of the directors of the defendant corporation, sent him a proof prospectus inviting him to underwrite shares, and after reading it he did so for the amount named. According to the prospectus the capital of the company was to be £225,000, in 200,000 preferred shares of £1 each and 25,000 deferred shares of £1 each, and the public were invited to subscribe £150,000 preferred, which amount was to be used for working capital. All the company had to get was a site upon which machinery and plant for electric power and lighting could be erected in order to supply various mining companies near Boulder City and Kalgoorlie, in Western Australia, the prospectus stating that a valuable site had been secured close to the Government railway adjoining Boulder City, situate on a flat, from which large supplies of water were obtainable. It was further stated that the area of the site was 24 acres, and the mining rights of considerable value had also been obtained. It afterwards transpired that certain important passages in the prospectus were untrue, and that the only document that the company could show was that they had "secured a valuable right," and that was not granted until March, 1900, six months after the plaintiff received the prospectus and bought the shares. It was said further by the defendants that the Great Boulder Perseverance Gold Mining Company and the Great Boulder Main Reef had promised co-operation, but it was found that they had, on the contrary, refused co-operation. As a matter of fact, it was alleged that all the companies in the district had said was that if the defendant company could supply them with power at least 20 per cent. cheaper than was done at that time, and would do so within a period of 18 months, they would give their support.

Mr. Arthur C. Bicknell, the plaintiff, an engineer by profession, was called, and gave evidence in support of his case. Cross-examined, he said he believed that the company was going in for supplying electric power and lighting, and for mining as well, but he was not anticipating that any profit would be made on the mining.

Mr. Lawson Walton: Do you suggest that there was the smallest difficulty in getting a site for the purpose of erecting dynamos and making electricity?—Witness thought there would be great difficulty in obtaining a suitable site.

Mr. Justice Grantham observed that from what he could understand the main question was that of getting a proper water supply for the electric machinery.

The Court adjourned.

On the case being resumed on 13th inst., Plaintiff was further cross-examined by Mr. Lawson Walton. He admitted that he saw a copy of the report issued to a shareholders' meeting last December. He was not present, but he had become aware that after the shareholders had been addressed by the chairman and directors, a unanimous resolution was passed adopting the report. He did not complain that the directors decided upon spending some little time in order to come to the best conclusion in the way of getting appliances for supplying the various mines with electric power and light, but he thought the company might have commenced sooner than they did. His recompense for underwriting was 25 £10 deferred shares.

Mr. Lawson Walton, opening the case for the defendant company, said that some £40,000 or £50,000 had been subscribed in actual cash by shareholders, a large proportion of which had been expended in electrical machinery on the site granted to the company, and it was at this particular stage, and against the whole body of the shareholders, that the plaintiff, long after all the facts were within his knowledge asked for relief. This action was not brought by a shareholder to whom the directors issued a prospectus, for plaintiff had only entered into an underwriting agreement for his own profit which did not primarily permit him to take shares. His obligation first of all was to guarantee that the public should subscribe 1,000 shares, and on that he received his commission in the shape of deferred shares. In short, plaintiff was left in this position, that if he had been misled at all, he had been misled by the underwriters, or rather by Mr. Wyman, who sent him the draft prospectus, and the firm of stockbrokers who had themselves undertaken liability for £125,000 shares, and his remedy, if remedy he had, must be against them. With reference to the plaintiff's allegation of fraud and misconduct against the directors of the company, counsel asserted most emphatically that the defendant company was founded and conducted by thoroughly honest and upright gentlemen, and it was very wrong indeed for plaintiff to make this attempt to impeach their character, and give effect to some unworthy feeling he entertained. He asked the jury to find for the defendants on the ground that in any ordinary business sense the statements in the prospectus were perfectly true; and even if there were some vagueness or slight inaccuracies in the language employed, it was idle for the plaintiff to say that he was misled by that into entering into this underwriting transaction.

Mr. Roger Wallace, K.C., examined by Mr. McCarthy, said he had been a director and chairman of the defendant company since its foundation. The directors had before them the reports of several experts, including Sir F. Bramwell and his partner, and when they put the statements made into the prospectus they believed them to accurately represent the substance of the experts' reports. As to the assertion that a valuable site had been secured close to the railway, at the time the prospectus was issued, the position was this. Their agent in Australia was the gentleman who had been made Premier a few days ago. They telegraphed to him. They knew that the vendor syndicate was in possession of the site, that they were working on the site, that application had been made for a lease, the actual document being in Australia, that borings had been made and water found. Further, they knew there was a mining right, and they had reports of gold having been found.

You had a contract with the syndicate that they were to furnish you with a site?—Yes; and until the lease was actually granted to us we did not hand over the consideration.

Mr. Justice Grantham: You believed from the information of your agent that the syndicate had rights over this site, but their exact form you did not know.

Witness added that for six months the syndicate remained in possession of the property, and went on with the necessary works for raising water. The company had since that time sent out valuable machinery.

Mr. McCarthy: And have the syndicate carried out all their engagements to you?—They have.

Do you say now that every statement in your prospectus was true?—I do.

Cross-examined by Mr. Clayton: Before he joined the board he made it a condition that the capital of the defendant company must be guaranteed. The only contract was by the syndicate to guarantee £1,500.

Were you aware that the total capital of the syndicate was £10,000?—I believe that the syndicate was registered with that capital, but I knew that a firm of stockbrokers had undertaken to take £125,000 shares. Witness knew at the time of the prospectus that there was a lease, but as it was in Australia, he could not produce it. The company had now the lease of the very property mentioned in the prospectus, and was established on the actual site mentioned.

By your report in December you say that after careful investigation of the lease you had come to the conclusion that there was not sufficient security afforded to warrant you in erecting plant and machinery on the site. I take it you had made no such careful investigation before you issued the prospectus?—I had not the document before me then. I insisted on making certain that after the term of 21 years there would be no doubt about the renewal of the lease before I put expensive machinery on the site. I did not want it as a favour from the Government.

For this valuable site £6 was paid and £1 per acre rental?—Yes, and I believe that in nearly all the valuable mining leases in the neighbourhood the same rental is fixed. There is a royalty on the gold, and that is the consideration that the Crown relies upon.

In further cross-examination, the Witness said that in the working of their electrical machinery the evaporation of the salt water was the great source of expense. It was, he considered, fair to say in the prospectus, without making any reference to this source of expense, that there were no engineering or electrical difficulties. They had a contract in Australia to supply electrical power at three times the price they would get in England, on account of the great cost of production.

Mr. McCarthy said there being a charge of fraud on the statement of claim, he tendered for cross-examination the rest of the directors.

Mr. Justice Grantham: The charge of fraud is withdrawn; they say they do not rely on it.

This being the defendants' case, the learned Judge summed up, and the jury found a verdict for the defendants.

E

Mr. Justice Grantham asked the jury if they believed the statements in the prospectus were true. The foreman replied that they did, whereupon

Mr. Rufus Isaacs said there was a second case, White *v.* Same, but in view of the jury's finding, it would be useless to go on with that, and he abandoned it.

Judgment was then entered for the defendant company on the claim and counterclaim, with costs, application for a stay of execution being refused.

Guildford Electricity Supply Company, Limited, *v.* the Mayor, Aldermen, &c., of Guildford.

In the Chancery Division of the High Court of Justice on June 14th, before Mr. Justice Byrne, Mr. Greig in this case moved for an injunction to restrain the defendants from removing, taking up, or otherwise interfering with the plaintiffs' cables in or upon the town bridge at Guildford.

Mr. F. Russell, for the defendants, asked that the motion might stand over for a week to answer affidavits. He stated that the bridge was damaged during the floods of last year, and his clients were doing certain necessary repairs.

In the result, by consent, the motion was directed to stand over for a week without prejudice to any of the rights of the plaintiffs under the statutes, the defendants undertaking not to remove more than 6 ft. more of the cable at the west side of the river, and also to replace cables so removed, if so directed at the trial.

The St. James's and Pall Mall Electric Light Co., Limited.

On Saturday, June 15th, in the Chancery Division, Mr. Justice Cozens-Hardy had before him the matter of the St. James's and Pall Mall Electric Light Co., Limited, and the Companies' Acts.

Mr. Thompson said it was an application under the Memorandum of Association Act of 1890 to enable the St. James's and Pall Mall Electric Light Co., Limited, to alter its memorandum by giving the company power to guarantee the repayment of the principal monies and interest to secure the debentures of a company to be formed for similar objects to the applicant's company. The circumstances under which they asked for this power to give the guarantee were somewhat peculiar, and were as follows: the St. James's Company was formed for the purpose of supplying electrical energy in its district, and by a provisional order which it had obtained, its area of supply was limited to St. James's, Westminster. The business of the company had increased so much that it proceeded to erect further generating stations, those which it already possessed being insufficient to provide for the wants of the company. Moreover, it was found, as would be easily seen, that its district was not eminently suitable for generating stations by reason of the difficulty it experienced in obtaining suitable land except at enormous cost, and other facilities in the shape of water and carriage. Accordingly a site was found outside the existing area of the company near to the Great Central Railway Company's property and the Regent's Canal, which was better adapted for the purpose of generating stations, and for the general supply of electricity. There was another company which was in a precisely similar position to the St. James's Company. Its area was limited to Westminster. Accordingly, these two companies formed a subsidiary company which was called the Central Electric Supply Company, and to which they contributed capital in equal shares. It was formed to enable them to erect the two stations which were needed to supply the two companies. It was promoted by the two companies in 1899 to acquire this site near the Regent's Canal, and the object of the company, as shown by the Act of Parliament, was for the purpose of supplying the two companies with electricity. The Central Electric Supply Company had purchased the land, but had found that it had not the capital needful to equip and construct the generating station. Practically, it was unable to borrow money on anything like reasonable terms unless it obtained the guarantee of the two companies, and they had the statement of the broker that it would be impossible to procure the money on the undertaking of one company alone. The capital of the company was £100,000, divided into preference and ordinary shares, and it was fully paid up.

Mr. Justice Cozens-Hardy: You have power to erect stations at St. James's and elsewhere.

Mr. Thompson: No doubt. They have power to erect stations and break up streets limited to the area of St. James's.

Mr. Justice Cozens-Hardy: I suppose that accounts for the state of the streets of London at the present time.

Mr. Thompson: No, my lord, that is due to the Government telephone, I am told. The learned counsel then referred to the provisions under which the company was promoted, which enabled them to form any companies or associations for any of the purposes mentioned, and to issue or guarantee the interest on any issue of debentures, and to dispose of any shares or securities thereof. In effect, this limited the guarantee to the payment of interest. What the company desired was power to guarantee the payment of the principal.

Mr. Justice Cozens-Hardy failed to see the difference.

Mr. Thompson said for certain purposes it was no doubt the same thing, but he submitted that a guarantee for the interest alone was not the same as a guarantee for the principal, and the bank had refused to advance any money on such a guarantee.

Mr. Justice Cozens-Hardy asked what the cost of the generating station would be.

Mr. Thompson said the amount required for the purchase of the land and the erection and equipment of the generating station was £350,000.

Mr. Justice Cozens-Hardy asked if there were any limitation of the applicants' borrowing powers.

Mr. Thompson said there was not—it was not an incorporated company. The Central Supply Company was really an accessory of the St. James's and Westminster Companies. Under the memorandum of association there was power to guarantee interest.

Mr. Justice Cozens-Hardy said the evidence bore out counsel's statements, and he would make the Order as asked.

Berrenberg Electric Lamp Syndicate.

The matter of Glasier *v.* the Berrenberg Electric Lamp Syndicate came before Mr. Justice Cozens-Hardy in the Chancery Division on Friday. The plaintiffs were the holders of 12 debentures of £100 which were issued by the defendant company in July last year. It was provided that the interest should become due on December 31st last, but no interest was paid, and under the terms of the debenture the principal monies became payable if the company made default for three calendar months' interest. Notice had been given to the company calling in the principal, and the debentures were, therefore, enforceable. Plaintiffs asked for the appointment of a receiver and manager, and the defendant company not opposing, his Lordship granted the application.

Hawkes *v.* the Leyton Urban District Council.

The case of Hawkes *v.* the Leyton Urban District Council was in the list to be mentioned to Mr. Justice Buckley in the Chancery Division on Monday, the 17th inst.

Mr. H. Terrell, K.C., on behalf of the defendants, said that the matter was before his Lordship on the last occasion on May 14th, on an application by the defendants to suspend the operation of a writ of sequestration granted by his Lordship and confirmed by the Court of Appeal, for breach of an injunction to restrain a nuisance caused to the plaintiff in the use by the defendants of gas plant in connection with their electric lighting works. His Lordship then made an order staying the operation of the writ over that day. The learned counsel read affidavits to the Court, which showed what the defendants were doing to substitute steam plant for gas plant, and by the consent of the other side his Lordship further stayed the operation of the sequestration for 18 months, with liberty to either party to apply in the meantime. It was stated that the gas plant had been disconnected.

The defendants were ordered to pay the costs of the present and the last application, which were directed to be included in the same taxation as the costs of the order of sequestration.

PARLIAMENTARY COMMITTEES.

Scottish Electric Light Provisional Orders.

The Examiner of the House of Lords has considered the Electric Light Provisional Order (No. 8) and found Standing Orders complied with, and it will now go before Committee. The Bill confirms the following orders granted by the Board of Trade:—

Clydebank, in the County of Dumbarton.—Order granted to the provost, magistrates and councillors in the Burgh of Clydebank.

Crieff, in the County of Perth.—Order granted to the provost, magistrates and councillors of the burgh.

Dalkeith, in the County of Edinburgh.—The undertakers are Messrs. Crompton & Co., Limited, and at any time within one year may transfer to the Electric Supply Corporation, Limited.

Dollar, in the County of Clackmannan.—Order granted to Messrs. Crompton & Co., Limited, with power to transfer to the Electric Supply Corporation, Limited.

Falkirk, in the County of Stirling.—Granted to provost, magistrates and councillors of Falkirk.

Galashiels, in the County of Selkirk.—Order to the local authority of Galashiels.

Gourock, in the County of Renfrew.—Granted to the provost, magistrates and councillors.

Jedburgh, in the County of Roxburgh.—Provisional order granted to Messrs. Crompton & Co., Limited, with power to transfer to the Electric Supply Corporation.

Melrose, in the County of Roxburgh.—Order granted to Messrs. Crompton & Co., with power to transfer to the Electric Supply Corporation.

Oban, in the County of Argyll.—Order granted to the provost magistrates and councillors.

Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board.

This Bill came before Mr. J. W. Lowther's House of Commons Committee on Unopposed Bills on 13th inst., and was ordered to proceed. It is a Bill to constitute and incorporate a joint board of representatives of the Corporations of Stalybridge, Hyde, Mossley and Dukinfield, and to authorise the Board to construct and work tramways and supply energy in the boroughs. It provides that as soon as the existing tramways shall have been acquired by the

Stalybridge Corporation under Section 43 of the Tramways Act, the same shall with all lands and other property be vested in the Board for the purposes of the Act. Power is given to enter into agreements with the Corporation of Manchester and the Corporation of Ashton-under-Lyne, and the Oldham, Ashton, Hyde and District Tramways Company with respect to running powers, supplying motive power, &c. Power is also given to acquire a piece of land situated in Stalybridge on which the gasworks now stand, and which belongs to the Corporation, and to erect thereon a generating station. By the passing of the Act, all property, rights, powers, privileges and authorities conferred upon or vested in the Hyde Corporation and the Dukinfield Corporation by virtue of the Hyde Electric Light Order of 1900, and the Dukinfield Electric Light Order of 1899, are transferred to the Board. The Board are authorised to supply electric energy in bulk to any authority within the district or adjacent, and the Bill provides that after all charges have been met for tramways and the generation and distribution of electricity, any surplus profits shall be equally divided between the four corporations.

City and South London Railway.

The Bill of the City and South London Railway Co. authorising an extension of time for the completion of the work and the raising of additional capital, which has been through the Lords, came before Mr. Lowther's Committee on Unopposed Bills in the House of Commons on 13th inst., and will now go to third reading.

Lewisham and Penge Electric Lighting.

The Electric Light Provisional Order Bill (No. 12) confirming the provisional orders granted by the Board of Trade in respect of the borough of Lewisham and the district of Penge, has been passed by the Examiner of the House of Lords as complying with Standing Orders. The undertakers in both instances are the Lewisham and District Electric Supply Company, whose registered office is 11, Charing Cross Road.

Dover Corporation Bill.

The Bill of the Dover Corporation on Monday passed the House of Lords' Examiner as complying with standing orders. The Bill authorises the Corporation to enter into agreement with the South-Eastern and Chatham Railway Company for the construction of a new street and new tramways, which shall form part of the tramway system of the Corporation.

West Cumberland Tramways.

The Bill to incorporate the West Cumberland Electric Tramways Company, and to empower that company to work tramways, make street improvements and erect generating stations, supply electricity, and for other purposes, which has already passed the House of Commons, came before the Examiner of the House of Lords on Monday, and was found to have complied with standing orders. It will now go for second reading in the Lords.

Bolton Corporation Bill.

This Bill, which has been through the House of Lords, passed the House of Commons Examiner on Monday as having complied with standing orders, and will go for second reading in the Commons. The Bill authorises the Corporation to construct a number of additional tramways in the borough.

Bradford Corporation Bill.

On Monday the Bradford Corporation Bill passed the Examiner of Standing Orders in ths House of Commons. The Bill empowers the Corporation to construct tramways, a portion of which are outside the borough, and to convert the existing tramways for mechanical traction.

L.C.C. Tramways.

The London County Council Bill to enable the Council to construct new tramways, and to reconstruct and alter tramways in the County of London, and to work tramways by electric traction, was before the Examiner of Bills in the House of Lords on Monday, and was found to have complied with standing orders.

Clyde Valley Power Bill.

The Clyde Valley Power Bill, which has passed the House of Commons, came before the Examiner of the House of Lords on Monday, for proof of compliance with standing orders, but its consideration was postponed.

Shannon Water and Electric Power.

Having passed the House of Commons, the Shannon Water and Electric Power Bill was before the House of Lords' Examiner for proof of compliance with standing orders on 14th inst. Further standing orders were ordered to be complied with.

Central London Railway.

The Central London Railway Bill came before the House of Commons Committee on Unopposed Bills on Monday, and was ordered to be reported for third reading. The Bill authorises the construction of loops at each end of the existing line.

Electric Light Provisional Orders.

Several electric lighting provisional order confirmation Bills were before the House of Lords' Examiner last week for proof of compliance with standing orders, and were passed.

Provisional Order (No. 9) confirmed the following orders granted by the Board of Trade:—

Alnwick.—Order granted to John Davison Milburn, of Newcastle-on-Tyne, colliery proprietor; A. Scholefield, shipping agent; C. W. Fairweather, of Newcastle-on-Tyne, electrical engineer; and C. S. V. Brown, Lincoln, electrical engineer, with respect to the Urban District of Alnwick, in the County of Northumberland. Powers are not to be exercised unless the undertaking is transferred to the Northern Counties Electricity Supply Company, of Newcastle-on-Tyne. Power is given to the local authority to purchase at any time after the expiration of a period of 10 years from the commencement of the order on two years' notice being given in writing requiring the undertakers to sell.

Annfield Plain Electric Lighting.—Order granted to the same undertakers on similar conditions.

Benfieldside.—Order for the lighting of this district to the Northern Counties Electricity Supply Company.

Consett, in the County of Durham.—Granted to same undertakers on same terms.

Handsworth, in the West Riding of Yorkshire.—Granted to the same undertakers on similar terms.

Norton, in the East Riding of Yorkshire.—An order granted to the undertakers for the Northern Counties Electricity Supply Company.

Pickering, in the North Riding of York.—Order granted to same undertakers as in preceding district.

Shildon, in the County of Durham.—Granted to the same undertakers, acting for the Northern Counties Electricity Supply Company.

St. Austell.—Order granted to the St. Austell and District Electric Light and Power Company, Limited, in respect of the urban and rural districts of St. Austell, in the County of Cornwall, and for revoking the St. Austell Electric Light Order of 1894. The registered office of the company at present is No. 1, Victoria Street, Westminster.

Whitley and Monkseaton, in the County of Northumberland.—The undertakers are Alan Geo. Robson, merchant, of Newcastle-on-Tyne; Athol W. Dixon, electrical engineer, of Newcastle-on-Tyne; and Jos. Abel Jeckell, electrical engineer, of South Shields. Powers of purchase are given to the local authority at any time after the expiration of ten years on one year's notice being given. The powers under the Order are not to be exercised unless the undertaking is transferred to a registered company approved by the Board of Trade.

Provisional Order Electric Lighting Confirmation Bill (No. 11) dealt with the following:—

Bromsgrove.—Provisional Order granted the Bromsgrove Urban District and part of the parish of Bromsgrove in the North Bromsgrove Urban District; and part of the parish of Stoke Prior in the Bromsgrove Rural District in the County of Worcester. The undertakers are Geo. Gordon, C. Steer, and Wm. Whitehouse; but the undertaking is to be transferred to the Bromsgrove and District Traction and Light Company.

Goole, in the West Riding of York.—Order to the Urban District Council.

Ilkley, in the County of York.—The undertaker is Alfred Horswell Gibbings, of Bradford. The local authority may within six months after the commencement of the Order require the undertaker to sell to them on payment of the sum of £150, but if power of purchase is not exercised by the local authority, the undertaker must transfer the Order to a company approved by the Board of Trade.

Lyndhurst, in the county of Southampton.—Order granted to the Lyndhurst Electric Light and Traction Company, whose registered address is No. 1, Palace Chambers, Bridge Street, Westminster.

Midland Electric Power Distribution and Lighting Extension.—Provisional order granted by the Board of Trade to the Midland Electric Corporation for Power Distribution, Limited, in respect of an extension of their existing order to supply to the Urban District of Tettenhall and the parish of St. Barr, both in the county of Stafford.

Northwood and Ruislip.—Provisional order granted to the Northwood Electric Light and Power Company, Limited, in respect of the parish of Ruislip, in the rural district of Uxbridge, in the county of Middlesex, and parts of the parishes of Watford and Rickmansworth.

Rickmansworth.—Order granted to the North Metropolitan Electrical Power Distribution Company in respect of the Urban District of Rickmansworth, in the county of Hertford.

Rishton, Great Harwood and Clayton-le-Moors.—The undertaker is Mr. C. Chadwell, of Blackburn, the powers to be transferred to a company approved by the Board of Trade. The order contains the usual powers for purchase by the local authority.

Warwick.—Provisional order granted to the British Electric Traction Company, Limited, in respect of the Borough of Warwick. Power is given at any time within one year after the commencement of the Order on the consent of, and upon such terms and conditions as may be approved by, the Board of Trade for the transfer of the

undertaking to the Leamington and Warwick Tramways and Omnibus Company, Limited.

The Confirmation Bill (No. 6) dealt with the following:—

Aberavon, in the County of Glamorgan.—To the Mayor, Aldermen and Burgesses.

Ashton-in-Makerfield, in the County of Lancaster.—The Urban District Council.

Hampton, in the County of Middlesex.—The Urban District Council.

Ince-in-Makerfield, in the County of Lancaster.—The Urban District Council.

Mountain Ash, in the County of Glamorgan.—The Urban District Council.

Neath, in the County of Glamorgan.—The Rural District Council.

Pontypridd, in the County of Glamorgan.—The Urban District Council.

Teddington, in the County of Middlesex.—The Urban District Council.

Worsley, in the County of Lancaster.—The Urban District Council.

Tramways in Yorkshire.

Before the Examiner of the House of Lords last week proofs of compliance with Standing Orders were given in the case of the order authorising the United Kingdom Tramway, Light Railway, and Electrical Syndicate, Limited, to construct tramways in the Borough of Pontefract, the Urban Districts of Castleford, Featherstone, Normanton and Whitwood, and the rural district of Pontefract. About 14 different tramways are scheduled in the Bill, two of them being each over one mile in length.

Weston-super-Mare Tramways.

Proofs of compliance with the Standing Orders of the House of Lords were afforded last week in the case of the Confirmation Bill authorising the construction of tramways in Weston-super-Mare. The promoters are the Weston-super-Mare and District Electric Supply Company, Limited.

Hopeman Tramways.

A Provisional Order Confirmation Bill was before the Examiner of Standing Orders in the House of Lords last week, and went through. The Order was confirmed authorising Sir William Gordon Cumming, Bart., to construct a tramway through the village of Hopeman, in the County of Elgin, of the length of 1 mile 7 furlongs and 1·20 chains.

Glossop Tramways.

Last week the Examiner of Standing Orders in the House of Lords passed the Confirmation Bill authorising the Urban Electric Supply Co., Limited, to construct tramways in the borough of Glossop. The tramways are two in number, the first being 4 miles in length, and the second 4 furlongs 5 chains.

Folkestone Corporation Tramways.

The Corporation Bill authorising the Folkestone Corporation to construct tramways within the borough passed the House of Lords' Examiner as having complied with Standing Orders last week. Under the Order the Corporation has power to construct two tramways, each a little over 1 mile in length.

Pontypridd Tramways.

Proofs of compliance with Standing Orders were forthcoming before the Examiner of Standing Orders in the House of Lords last week in respect of the Corporation Bill of the Pontypridd Urban District Council, authorising them to construct tramways within their district.

Northampton Tramways.

The Examiner of the House of Lords last week passed the Bill confirming the provisional order to the Corporation of Northampton, giving them power to construct additional tramways, and conferring further powers with regard to tramways already constructed.

Liverpool Tramways.

The Bill authorising certain extensions to the existing system of electrical tramways of the Liverpool Corporation was found to comply with the standing orders of the House of Lords by the Examiner last week.

Devonport Corporation Tramways.

The order amending the Devonport Corporation Tramway Order of 1899, with respect to the commencement and opening for public traffic of the tramways therein authorised, passed the Examiner of the House of Lords last week as having complied with standing orders.

Ashton-under-Lyne.

The Bill confirming the provisional order to the Corporation of Ashton-under-Lyne passed the House of Lords' Examiner for proof of compliance with standing orders last week. The Bill authorises the construction of additional tramways within the borough, and confers further powers in regard to existing tramways.

Denton Tramways.

The Provisional Order Bill giving the Denton Urban District Council power to construct tramways in the district was found by the Examiner of the House of Lords last week to have complied with the Standing Orders, and will go for second reading.

Bexley Tramways.

The Bexley Tramways Bill, which has passed the House of Commons, was before the Examiner of the House of Lords some days ago for the necessary proofs of compliance with Standing Orders, and the Bill was passed.

Coatbridge Tramways.

The Tramway Provisional Order Confirmation Bill (No. 4) was before the Examiner of Standing Orders of the House of Lords last week. The order authorises the Airdrie and Coatbridge Tramways Company to construct and work tramways in the Burgh of Coatbridge. No. 1 tramway is 1 mile 6 furlongs and 2·30 chains in length; No. 2, 2 furlongs and 2 chains; No. 3, 1 furlong and 8·30 chains; and No. 4, 1.60 chains. The necessary proofs of compliance with Standing Orders were given.

Blackburn Corporation Bill.

Mr. J. W. Lowther's Committee on Unopposed Bills last week considered the Omnibus Bill of the Blackburn Corporation which, amongst other matters, seeks to reconstruct existing tramways and construct additional lines. The estimated cost of the tramway works is £152,000. The preamble of the Bill was found proved, and the measure ordered for third reading.

Wigan Corporation Bill.

The Omnibus Bill of the Wigan tramways passed the Examiner of the House of Commons last week as having complied with the Standing Orders, and will go for second reading. It has already passed the Upper House. The Bill gives powers with regard to electric lighting and tramways.

South Lancashire Tramways.

This Bill, which has passed the House of Lords, was before the Examiner of Standing Orders of the House of Commons for proofs of compliance with Standing Orders last week, and was ordered to go for second reading.

Chester Corporation Tramways.

The Bill of the Chester Corporation, authorising them to reconstruct existing tramways for mechanical traction and construct additional tramways, which has passed the House of Lords, was some days ago found to have complied with the Standing Orders of the House of Commons before the Examiner.

Tyneside Tramways Bill.

The Tyneside Tramways and Tramroads Bill, which has been through the House of Lords, came before the Examiner in the House of Commons the other day, and the Standing Orders were found to have been complied with. Powers are taken under the Bill to extend the tramways between Newcastle and Tyneside.

Underground Electric Railways.

On 14th inst. Lord Knutsford presided over the Joint Committee inquiry into the electric underground railway schemes before Parliament this session.

Evidence was called on behalf of the various omnibus companies to show the number of passengers carried, and to prove that with respect to some of the tubes proposed, the traffic would not be sufficient to make the railways remunerative.

Mr. Erskine Pollock addressed the Committee for the Omnibus Companies, and pointed out that with the Omnibus Companies carrying 400,000,000 passengers per year, it meant that they had a considerable knowledge of the wants of London, and it also meant that there was a considerable amount of capital involved. If the tube railways reduced the percentage of passengers per bus it would probably mean that with reduced receipts the directors of the Omnibus Companies would not go to the risk and expense of opening up new routes, and consequently the public would not be benefitted in the long run.

Lord Robert Cecil, K.C., called Sir Henry Oakley to clear up a point as to the Paris underground railway having a loop at each end, and proved that such was the case.

Sir Alexander Binnie, examined by Mr. Fitzgerald, stated that he had been for 12 years chief engineer of the London County Council, and had had experience of constructing railways both in this country and in India. He had given considerable attention to the question of metropolitan railway construction, and had full knowledge of all professional matters. With regard to these tube railways the L.C.C. and City Corporation had met and conferred together, and he had been instructed to put forward the views of both bodies. There were 13 deep level railways already authorised. The City and South London, the City and South London Clapham extension, the Central London Railway and the Waterloo and City were open for traffic, the City and South London Islington Extension, the Great Northern and City and the Baker Street to Waterloo were in course of construction, and the Charing Cross, Euston and Hampstead, the Brompton and Piccadilly, the City and Brixton, the Great Northern and Strand, the North-West London, and the Metropolitan District were authorised. The lines proposed that session were the Brompton and Piccadilly Extension, the Central London Extension, the Charing Cross, Euston and Hampstead, the Charing Cross, Hammersmith and District, the City and North-East Suburban, the Islington and Euston, the King's Road, the North-East London, the Piccadilly and City, and the West and South London Junction. All the tube railways at present constructed were constructed on the 4 ft. 8½ in. gauge, so that the rolling stock could pass on to the general system of railway companies, provided that the station platforms conformed to the peculiar type of rolling stock. But the rolling stock of an ordinary railway could not very well pass into the tubes, as they were precluded by the size of the tunnels. The only exception was the Great Northern and City, which was 16 ft. 6 in., so that the ordinary rolling stock of the Great Northern Railway could pass down to Finsbury Circus. The construction of lines like the Metropolitan and the Metropolitan District Railways meant enormous expense, and a further advantage of tube railways was that they could be constructed without interference with the sewers and gas and other mains. It must, however, be a *sine qud non* of economical construction that the tube railways should go through London clay, for, although part of the South London Railway was constructed through a water-bearing stratum, the work had to be done by the compressed air process, and that necessarily added enormously to the expense. He advocated that the lines should be worked either on the shuttle system or the closed circuit system. By the circuit he meant running round a circuit without any interference from trains coming in from other lines. Confluent junctions, he thought, would render them almost unworkable, although end-on junctions might be made and would facilitate the traffic. To carry out his view there would have to be interchange stations such as that which already existed at the Mansion House. They would have to be constructed underground and connected with subways. He did not think they could regard the tube railways in the same light as the ordinary railways of the country. Coming to the question of routes, the general principle he would advocate that they should radiate the densely populated districts or connect directly east and west, north and south. The central parts which were densely populated were the City, the eastern part of Westminster, Holborn and Finsbury. The principal points of traffic concentration were Piccadilly Circus, the Oxford Street end of Tottenham Court Road, Charing Cross, the Law Courts, the Bank, and Liverpool Street station. He considered that one central station only was undesirable, and thought that as far as possible the railways should follow the course of the old main roads out of London, while the routes under the great trunk railways might be used to relieve the enormous flow of traffic at certain hours of the day. If the lines went under private property it might be sufficient that they should pay for easements and any damage done without being required to purchase the property. As many of the great railway termini are not situated in the commercial parts of London, great public convenience might accrue were they connected with the business parts of the metropolis. A good illustration of what he meant was afforded by the Great Northern and Strand Railway, which, commencing at Finsbury Park, passed under the existing Great Northern Railway and its terminus at King's Cross, and continued through Bloomsbury and along the new street from Holborn to the Strand, and terminated near the Law Courts. Witness proceeded to take the various schemes in detail, mapping out London into various areas, and suggesting how the projected railways might best be regulated and managed so as to obtain a maximum of benefit for the public. There was a dearth of accommodation of electric railways projected or constructed in the east and south-east portions of London, but that was due, he believed, to the difficulty of finding watertight strata in these areas. With regard to routes which would be most broadly serviceable, he gave a line connecting Paddington with Victoria, which might go into the area lying between the Great Western and the North-Western systems, a line along Victoria Street and Whitehall to Charing Cross. Other lines might be from the Marble Arch to Cricklewood, the Baker Street and Waterloo line, with extensions to the South London Railway, the Charing Cross, Euston and Hampstead Railway, and the West and South London Junction Railway. The total money powers for existing and proposed lines were £48,000,000, and in connection with the finance side, economical construction was most important in the public interest, as over-capitalisation checked development. The Waterloo and City line had been most economically constructed, and construction and equipment only came to £400,000 a mile, although it was a very difficult line to construct. On the other hand, the Central London Railway, which was an easier line to construct, but which was constructed through the intervention of a financial syndicate, cost £554,000 per mile for construction and equipment. He advocated the raising of capital in the most economical way in the public interest, and he considered that investors might expect a fair rate of interest for their money, but the £48,000,000 which he had mentioned, was too large to contemplate at present, and it was evident that some of the proposals would have to be abandoned, and others rejected. Some of the lines would be incompatible with a good scheme of London communication, some of them confluted with each other, while in other cases ground would be occupied which could be better utilised. The Metropolitan District Railway had powers to construct a deep level line under their present line from Earl's Court to the Mansion House, but it was evident that in the present financial position of that company, the line could not be carried out for years, especially as it was proposed to substitute electric traction on the existing lines. The result was that the existence of these powers by the company prejudiced the whole system of communication, and the powers were in direct competition with the proposals of the Charing Cross and Hammersmith line. He considered there should be some general control over the working arrangements of the different lines, and instanced the lack of agreement between the Metropolitan Railway and the District Railway to show how the public service suffered.

Mr. H. L. Cripps, Parliamentary agent to the London County Council, stated that that body having considered the proposals as a whole did not think them entirely satisfactory. The various schemes were promoted by rival parties, and the Council wished to see a comprehensive scheme for dealing with the question of London traffic. The Council's suggested purchase clause with with regard to the Central London Railway was rejected, and, speaking personally, he thought that the insertion of a purchase clause might render it more difficult for the promoters to get the public to subscribe the necessary capital for the constructing of tube railways. The point of a general control of the working of the line ought to be adopted from the start, as it would result in great economy. The Central London Railway had met the County Council very fairly with respect to workmen's fares, but the Council had to make a separate arrangement with each company, and there were no through workmen's fares. If the routes were under one management, the fares throughout the whole country should be the same. He considered that it would be a good thing if the Metropolitan Railway had power to construct a deep level railway under the inner circle, so that they might join with the District Railway. A suggestion had been made that the South-Eastern station at Charing Cross might be removed to the south side of the Thames, and if that were done it might materially modify the direction of underground routes.

The Committee adjourned till Tuesday.

London United Tramways Bill.

The Bill of the London United Tramways Bill came before a Select Committee of the House of Commons, presided over by Sir J. Kennaway, on 13th inst. Mr. Balfour Browne, K.C., Mr. Fitzgerald, K.C., and Mr. L. Coward, K.C., were for the promoters, and the petitioners against the Bill were the Southwark and Vauxhall Water Company, the East and West Molesey District Council, the Chelsea Waterworks Company, the Brentford Urban District Council, Surbiton Urban District Council, Lambeth Waterworks, Middlesex County Council, Wandsworth Corporation, Surrey County Council, New River Company, West Middlesex Water Company, Grand Junction Waterworks, Kingston-on-Thames Corporation, Richmond Corporation, owners of Upper Richmond Road, Heston and Isleworth Urban District Council, Hammersmith Corporation, Hampton Urban District Council, various frontagers, London County Council, and owners and occupiers of Kingston-on-Thames.

Mr. Balfour Browne, in opening the case, said the Bill was for extending the system of the London United Tramways Company, and the extensions were in three different groups. The first proposal was for tramlines through Kingston and Surbiton, and these tramways were coupled with the authorised lines at Kingston Bridge and Hampton Court Bridge. These tramways were separate from the other proposals, which were to construct a line from Kew Bridge through Richmond, Barnes, and Putney, to Hammersmith Bridge, and a short line along the Bath Road in Isleworth. The main opposition of the water companies was that the clause in the Bill which protected their pipes from fusion and electrolytic action was not sufficient. That was an entirely separate matter, and he had arranged with Mr. Pember that it should be taken separately. At present 40 miles of tramways were authorised. One part of the system began at Shepherd's Bush, at the terminus of the Central London Railway, and ran along the Uxbridge Road to Hanwell and Uxbridge, and the other part commenced at the Hammersmith Broadway and ran through Chiswick, Hounslow, Twickenham, Teddington, and Hampton Wick. Of the authorised lines 16 miles were now constructed, and 7 miles 4 furlongs were being worked by electricity. The portions already worked were from Hammersmith to Kew Bridge and to Hanwell. The success had been marvellous, and in 10 weeks they had carried 5,048,208 passengers, and on Whit

Monday on their 60 cars they carried 210,557 passengers. Reverting to the first scheme proposed, viz., that in Kingston and Surbiton, counsel explained that the length was 12 miles 6 furlongs and 6 chains, and the only opponents were the Middlesex County Council. Altogether, apart from the cost of construction of the tramways, they were expending £55,043 on road improvements to the local authorities, and they were also under an agreement to pay £10,000 towards the cost of reconstructing Kingston Bridge, should it be necessary. But in addition, the local authorities had agreed to extend the period for purchase from 21 to 25 years, and for that concession, they had agreed to pay to Kingston from £225, rising to £700 a year for 10 years; to Surbiton £300, rising to £500 a year; to Esher and Thames Ditton £150 a year, and to East and West Molesey £100 a year. The proposed light railways of the Middlesex County Council were to the north of the county, and right away from the company's systems.

The CHAIRMAN asked if the Middlesex County Council objected to the financial standing of the company.

Mr. BALFOUR BROWNE said there was no fear of finance when they carried 5 millions of passengers in 10 weeks. They had recently issued £350,000 of debentures, which had been subscribed for five or six times over. Any talk about financial stability was but the irresponsible frivolity of the County Council.

Mr. JAMES CLIFTON ROBINSON was called with respect to the Kingston and Surbiton portion of the Bill, and said he was managing director and engineer of the company. The line from Shepherd's Bush to Southall had been constructed, and would be opened on July 1st. From Kew Bridge to Hounslow the line had been constructed for some time, and that also would be opened on July 1st. On July 1st they would have 150 cars in operation. Witness proceeded to bear out counsel's opening statement with respect to the arrangements made with local authorities for street improvements and widenings. There were no engineering difficulties with regard to the bridges across the Thames, which it was proposed to go over. They expected to carry over 52,000,000 passengers a year when the tramways were opened. They were fed by the Central London Railway, and looked forward to the time when the fare on that railway would be reduced. He expressed the opinion that small isolated tramways had never, and would never pay.

WITNESS was cross-examined at considerable length by counsel for various opposing frontages, and pointed out that where the local authorities objected, they had to drop the tramways.

Lord R. CECIL, K.C., who appeared for the Middlesex County Council, put it to witness that he had written to the *Times* to the effect that owing to the privileges of local authorities under the Standing Orders of Parliament, it was almost impossible for tramway enterprises to be carried out, as it led to the local authorities practically blackmailing a company. Counsel explained to the Committee that his point was that a company so hampered could not carry out a tramway scheme in the best interests of the public, and that consequently it should be left to an authority like the Middlesex County Council.

Sir J. KENNAWAY said the answer to that was that the Middlesex County Council were not in time, as the company were already there.

Lord R. CECIL said he might ask that the company should not be allowed to go further.

In further cross-examination, WITNESS said he had stated that the Surbiton Urban District Council had blackmailed the company, but he used the phrase because he could not find a wider one. He could say they had exacted money from the company.

The Committee adjourned.

On Friday, Mr. G. M. WALKER, chairman of the Surbiton Urban District Council, was the first witness called, and stated that while personally not in favour of the tramways, he had voted for them because there was a widespread feeling in favour of them. He denied that the Council had been bribed by the company, although the Council had done the best they could for the ratepayers.

A number of Surbiton residents were then called in favour of the scheme.

Mr. J. W. HORSFIELD, member of the Kingston-on-Thames Town Council, and surveyor to the Hampton Wick Urban District Council, stated that there would be no difficulty in widening Kingston Bridge and improving the approaches.

Mr. HOWELL, surveyor to the Surrey County Council, said he thought they must have tramways in the district, and if so they must go over the two bridges mentioned so as to be connected with the system on the other side. He thought the bridges could be strengthened.

Lord R. Cecil then called Mr. J. E. WALLER, M.I.C.E., and Mr. F. T. WAKELAN, engineer and surveyor to the Middlesex County Council, who expressed grave doubts as to Hampton Court Bridge being strong enough to carry the tramways.

This concluded the case with regard to the Kingston and Hampton Court bridges, and the Committee reserved its decision until the whole of the proposals were threshed out.

Local evidence in opposition was then called from Surbiton, the witnesses contending that the tramways were not required in that place, and would ruin the place as a residential suburb if allowed.

On resuming on Monday the Committee heard evidence in opposition to the scheme on behalf of Mrs. Shrubsole, the owner of a mansion at Kingston.

Mr. BALFOUR BROWNE, K.C., explained the proposed Bath Road tramway to Heston and Isleworth. The line would run from Hounslow, to which place the company's tramway was not only authorised but was constructed, and from whence they would commence running cars on July 1st. The only opponent was the Middlesex County Council. The road was a wide one, and no widening would be required. The County Council wanted to become the owners of the whole of the tramways in the county, but they were too late. Since the Bill had been in Parliament, the County Council had deposited with the Light Railway Commissioners an application to make a tramway along the Bath Road, where their tramways were proposed, so it could not be urged that the road was not suitable for a tramway. The County Council said that they had made themselves the light railway authority by passing a resolution, but he (Mr. Browne) denied that they had any such power. He did not hesitate to say that the application to the Light Railway Commissioners was not a *bonâ fide* intention to construct a tramway, but was intended to block the tramway company getting powers. The extension was supported by the Heston and Isleworth local board, and he hoped the Committee would not lend itself to allowing the Middlesex County Council to stand in the way of the convenience of the general public.

Evidence was then tendered by Mr. CLIFTON ROBINSON, the engineer to the promoting company, explaining this portion of the scheme, and witnesses were next examined representing the Hounslow Urban District Council in favour of the Bill.

Witnesses were then called on behalf of the Middlesex County Council in opposition to the scheme, among them being Mr. COOPER, electrical engineer, who said he had laid out the light railway scheme of the Council, and in his opinion the section along the Bath Road was essential to the scheme as a whole. It would be practically impossible to carry out that scheme if that portion of the route was taken away from the Council and given to the tramway company. The Council had received a letter from the District Railway, in which that company stated that if the Council constructed a light railway along the Bath Road to the terminus of the District Railway at Hounslow they would allow a rebate on traffic brought to them over the light railway, or they would enter into a working arrangement with the Council to work the lines and run through cars from the light railway on to the District company's lines.

Replying to the CHAIRMAN, WITNESS said that plan would be carried out by widening the line on the Bath Road and running the cars by electricity up to Hounslow,

In answer to Mr. FITZGERALD, Mr. COOPER said that an agreement had been entered into with the Metropolitan Tramway and Omnibus Company to work the lines if, and when, sanctioned. That company had reserved to themselves the right of refusing to work any line of which they might disapprove. He had heard that they had sent a letter stating that they would not work several of the lines on the ground that they were not likely to be of any commercial value for some time to come, and among the lines they refused to work was the proposed Bath Road tramway.

Mr. BIGWOOD, M.P., said he represented the Brentford division of Middlesex, and was chairman of the Parliamentary Committee of the Middlesex County Council. In February, 1899, the Council passed a resolution under which they decided to construct certain lines of light railways. In his opinion it was a matter of the greatest importance to the public that there should be a central authority, which should produce a comprehensive scheme with the object of covering any given district with a network of light railways to produce rapid and cheap locomotion. Where possible the County Council worked in harmony with the local authorities and were always anxious to meet their wishes as far as possible. They did not object to the local authorities constructing tramways so long as they did so in accordance with the plans of the County Council. The County Council did not consider the question of profit so much as the question of affording the population increased facilities for cheap and rapid travelling—they were satisfied that the profit would come in good time.

Lord ROBERT CECIL addressed the Committee on behalf of the Middlesex County Council, and said the view of his clients was that it was in the interests of the public in general that the light railways of the county should as far as possible be in their hands. The great majority of the roads which the tramways would traverse were owned by the County Council, who also contributed towards the maintenance of the Bath Road. Under those circumstances it was only reasonable that anybody who was going to occupy the surface of that road should be under the control of the County Council, and the principle that the road authority should have authority over tramways had been recognised by Parliament. He asked the Committee not to hamper the Middlesex County Council in the work they proposed to do in the public interest in the western portion of the county. The Bath Road section was vital to the development of the Council's scheme in West Middlesex, and if they did not gain their point in that respect the whole scheme would be very seriously injured. With regard to the rebuilding of the bridges, it would be the height of injustice to put upon the Middlesex County Council the burden of reconstructing those bridges at a very much earlier period than would otherwise be necessary, and only to offer them a very small proportion of the cost.

The Committee then adjourned.

On resuming on Tuesday, Mr. HALSEY, chairman of the Surrey County Council, gave evidence in favour of the scheme. He said that some two or three years ago there were indications that the London County Council intended to apply for powers for a light railway of their own, and his Council rather resented the idea that another county authority should come into the county. They, therefore, turned their attention to considering what had better be done, and some of them were of opinion that the Surrey County Council was the proper authority for combining all interests con-

nected with tramways, and they propounded certain schemes. A great many discussions took place on the matter at the Council meetings, and on one occasion a majority of the Council approved of that body being the authority; but in order to make such a resolution operative, they required a two-thirds majority. Upon that they came to the conclusion that if they were not to be the light railway authority, the best thing they could do was to see that some responsible body took up a complete scheme, and that they should be subject to such control as the local authorities could obtain. The scheme now under the consideration of the Committee was to a very large extent the scheme which the Surrey County Council themselves propounded, and in their opinion the people now applying for powers were quite capable of doing what they proposed, and were also capable of carrying out the extensions when they considered the time was ripe for them. He thought that the extensions had been well planned, and that they would meet the convenience of the public.

Mr. BALFOUR BROWNE, K.C., then introduced the third and last group of tramways proposed to be constructed. He explained that the line commenced at the Broadway, Hammersmith, and after running for a little way through the County of London, over Hammersmith Bridge, it entered the County of Surrey, running along Bridge Road to the Upper Richmond Road, from whence it would proceed to Putney on the one hand and to Richmond on the other, and then on to Kew Bridge. The total length of the tramways was eight miles. There were four local authorities interested—the Richmond Corporation, the Urban District Council of Barnes, the Hammersmith Borough Council, and the Wandsworth Council, and the only objector was the last-named Council, who wished to insist upon the promoters widening the road to 50 ft. throughout. That was impossible and unnecessary. The company proposed to carry out widenings which would cost £79,458, which was all that was required. There were also objections from certain frontagers along the line of route, but he believed the Committee would agree that the advantage to the public was so great that these objections should not be allowed to stand in the way.

Mr. CLIFTON ROBINSON, general manager and engineer to the company, gave evidence bearing out the opening statement of counsel, and said that there was already a tramway running from Kew Bridge to Richmond, which was to be superseded by an electric tramway.

Evidence was then given by Mr. W. J. Bull, M.P., L.C.C., Mr. T. Skewes-Cox, M.P., Sir James Szlumper (Mayor of Richmond), and other local representatives in support of the scheme, and the Committee adjourned.

ELECTRIC LIGHTING IN MARYLEBONE.

THE Electric Light Provisional Order (No. 1) came before Mr. Lowther's Committee on Unopposed Bills in the House of Commons on Tuesday, and was reported for third reading. The Bill gives electric lighting powers to the Metropolitan Borough of Marylebone.

ELECTRIC POWER DISTRIBUTION ON TYNESIDE.

THE new power station of the Newcastle Electric Supply Company, at Neptune Bank, Wallsend, was inaugurated on Tuesday, July 18th, by Lord Kelvin. There was a considerable number of guests at the opening ceremony, and they had a most interesting day, having the privilege of witnessing the formal commencement of what seems likely to develop into an enormous industry. The present plant consists of three triple-expansion engines, each capable of indicating 1,400 H.P., coupled to Thomson-Houston alternators, generating three-phase currents at a pressure of from 5,500 to 6,000 volts and a frequency of 40 cycles per second. After half an hour's stay in the power station, the visitors proceeded to the Northumberland Forge, to visit the North-Eastern Marine Engineering Company's works and the sub-station which supplies electric energy to them. Thence they went to Willington Quay to inspect the electric installation of the Northumberland Shipbuilding Company, Limited, and passed the works of Messrs. Wigham, Richardson & Co., Limited, and Sir W. G. Armstrong, Whitworth & Co., Limited, to which electric energy is supplied from the power station, on the way to the Drill Hall, Walker, where they were entertained to luncheon by the chairman and directors of the Newcastle-upon-Tyne Electric Supply Company, Limited, and the Walker and Wallsend Union Gas Company, who are responsible for the undertaking. Sir Andrew Noble, K.C.B., presided at the luncheon, and was supported by Lord Kelvin, Dr. G. T. Merz, Alderman T. G. Gibson, Dr. R. Spence Watson, Mr. J. H. Armstrong, and Mr. F. W. Dendy, of the Newcastle Electric Supply Company; Mr. T. Crawford, Mr. G. A. Allen, Mr. J. R. Lownds, and Mr. C. W. Mitchell, of the Walker and Wallsend Union Gas Company.

Sir ANDREW NOBLE, in calling upon Lord Kelvin to inaugurate the electric power supply on Tyneside, pointed out that this country, in the practical application of the great inventions of the last century, had not made the same advance as many nations upon the Continent and as America had done. He attributed this, in some measure at least, to the restrictive measures that had been placed upon manufacturers by the Government, and cited two cases in point. First, the Government made no move itself to supply the country with telephones upon reasonable terms, but it would not allow anybody else to do so. The second case was with regard to the introduction of electricity. Restrictive measures prevented the development of the application of electricity by the private manufacturer, and the consequence was that we found the Continent and America ahead of us in the practical application of electricity, although for masters in the science England could compare favourably with any other country. He had some fear that these restrictions might be continued, having regard to the efforts that were made by some corporations to get the manufacturing power into their own hands, and to the restrictions upon private manufacture. It was greatly to the advantage of the country that manufacturers should be left as free as possible.

Lord KELVIN formally declared the electric supply on Tyneside to be open. It was only the beginning, on a scale which a few years ago they would have called a very large scale, but which the Newcastle Electric Supply Company now regarded as only a small part of what it was going to do; larger works were already in prospect. What was contemplated by the Newcastle Electric Supply Company was to give power to large consumers, taking perhaps from 200 to 500 H.P., using that most admirable motor the three-phase motor. The electrical energy would be transmitted to the factories at high pressure, and transformed to a pressure suitable for direct connection with motors scattered through the works. This was the first, and from one point of view the largest field of operations proposed by the Newcastle Electric Supply Company. The second object was to supply low pressure direct current for lighting and power. It was anticipated that for small users this system might be preferred to the three-phase system, not merely in connection with the quantity taken, but from certain considerations regarding the convenience in use. They had that day seen the North-Eastern Marine Engineering Works using 500 volts direct current driving motors throughout the works. In the yard they saw a 90-ton load under a sheer-legs driven by a direct-current motor. They saw cranes of various powers, all working, or ready to work, by these motors. They saw a travelling crane over the whole length of one of the main shops; and they saw, side by side with it, a square rotating shaft the whole length of the shop—a monument of the past. They would understand that there might be a reason for choosing continuous-current motors in these departments. A great deal of the work had to be done at various speeds, and the machine must go fast or slow. That, he believed, was the governing reason—the facility for running at different speeds. In the present state of electric practice and electric invention, it was not quite so easy to run a three-phase motor exceedingly slowly, and at all different speeds, up to the highest speed, with fairly good economy. That, he thought, was sufficient reason for choosing the direct-current motor. The Northumberland Shipbuilding Company's yard was, in some respects, even more interesting to the whole world. Not many of them had seen the three-phase current actually at work in factories. If they had been in America, and seen the great work that had been done there, they would not look upon that so much as a novelty. The three-phase motor system had been splendidly developed in America and Germany and in Switzerland—especially in Switzerland, and it was largely coming into favour in this country. But he did not know any place in which it had been used for taking power from a distant supply station, and working a factory by means of it. The Northumberland Shipbuilding Company had all its power work done now by three-phase motors, supplied from the Neptune Bank power station. There were just one or two exceptions—one direct-current machine for electric lighting, and for power for very small repairs. It was interesting to note that this three-phase system of distribution gave absolutely fair play both to direct current for the lighting of towns and for the supply of small motors, and to the largest motors. A great boon had been conferred on Great Britain by the work that was now inaugurated. The third object was supplying direct current for tramways outside of Newcastle; the fourth was the supply of direct current in the City. Lord Kelvin ended by proposing "Success to the Companies."

Dr. J. T. MERZ, chairman of the Newcastle Electric Supply Company, and Col. T. CRAWFORD, chairman of the Walker and Wallsend Union Gas Company, replied, and the proceedings then terminated.

CORRESPONDENCE.

The Musical Arc.

I notice in your last issue under the heading "The Musical Arc," a short abstract of a paper in the *E.T.Z.*, by Prof. Peukert, in which you say:—"In the musical arc *discovered by Simon* we have an exceedingly convenient means of producing alternating currents of very high frequency," and also "*Peukert has discovered* that no telephonic or other vibrator is necessary to start the oscillations in the shunt circuit of the arc. All that is necessary is to close the circuit, whereupon the electric oscillations start automatically."

May I be allowed to point out that this is precisely the effect that I demonstrated at the Institution of Electrical Engineers in December last, and which I named the musical arc.

I believe that Simon discovered that the arc could be used as a *telephone transmitter and receiver*, and judging from the original article, I think that Prof. Peukert has *rediscovered* some of the effects which I published in December last.

Besides giving a brief description of the experiments in my paper, I pointed out the necessary conditions that the arc must fulfil in order to make this transformation, by the arc, of direct current energy into alternating current energy possible. I also stated that frequencies up to 10,000 ~ per second could be obtained.

W. Duddell.

London, *June 15th*, 1901.

Sedneff Cells.

We have pleasure in sending you enclosed comparative results of secondary batteries.

We have tested these Sedneff cells as well ourselves, and can only say that we can verify these figures to anyone for whom they have any interest.

The Electrical Company, Limited.
J. STOTTNER, *General Manager.*

A very marked advance in the construction of accumulators intended for the propulsion of vehicles on common roads has been made in the Sedneff accumulator, as shown in the following tables:—

COMPARISON BETWEEN THE SEDNEFF ACCUMULATOR AND THE BEST-KNOWN FRENCH TYPES FOR TRACTION PURPOSES.

Accumulators.	Rate of discharge per sq. dec. of positive surface in amperes.	Energy in watt-hours		Normal power in watts	
		per 1 kg. of plates.	per 1 kg. of cells.	per 1 kg. Plates.	per 1 kg. Cells.
Acc. de la Socté pour le Trav. Elec. de Métaux	1·30	20·80	14·70	5·83	4·10
Faure - Sellon - Volckmar	0·618	31·30	19·80	5·70	3·60
	0·480	30	19·80	5·00	3·30
	0·540	20	15	4·00	3
Fulvis	0·156	25	18·25	5·00	3·65
Phœbus ...	1·15	26·30	18·50	5·26	3·70
Pisca	1·20	16	12	5·30	4
B.G.S.	0·745	41	27·8	7·9	5·4
Fulmen ...	0·98	36	25	7·2	5·1
Sedneff A (for tramway traction and stationary work with heavy negatives)	3·47	24	18·50	9·68	7·3
	In actual work for three years, viz., reports on tests by Siemens & Halske, Charlottenburg, and by the Electrical Company, Limited, London.				
Sedneff B (with zinc negatives and patent electrolyte for light automobiles)	2·36	47·2	32·1	12·32	7·8

As will be seen, the highly remarkable result of 32·1 watt-hours per kg. of complete cell has been obtained at a rate of discharge of 2·36 amperes per square dec. of plate, which enables a horse-power-hour to be secured by means of a total weight of battery of 51 lbs. The construction of Sedneff accumulators is such that distortion or buckling of the electrodes does not occur under the severest imaginable working conditions, not even on continued short circuits, while their cost in the first instance is considerably lower.

Inexpensive Mirror Galvanometers.

We notice a letter in this week's REVIEW by Prof. A. P. Carman which seems to describe what is practically the cheap form of dynamo-galvanometer brought out by us some 14 years ago, and described by you at length in your paper of that date. This galvanometer, which has sold largely, is as cheap as the one he mentions, and can be obtained at any time without the trouble of making, being a stock article.

P. Jolin.

Bristol, *June 14th*, 1901.

I notice an article in the current number of the ELECTRICAL REVIEW, on p. 1041, entitled "An Inexpensive Mirror Galvanometer." The description given by Prof. Carman is a very good one, but there is one statement which is very misleading and which refers to the figure of merit of this instrument, where he states that he gets 48 divisions per micro-ampere, as against Nalder's instrument 3·62 divisions, and Hölden galvanometer ·54 scale divisions per micro-ampere. This figure of merit, of course, depends on the time of swing and length of suspension of the galvanometer, which are not mentioned by Prof. Carman as being identical in each case. This instrument fitted with a pointer and scale is very useful also in electric works for testing various resistances. We propose using an instrument of this kind for testing the insulation resistance of switch lamp-holders and tumbler switches before they leave these works. The testing will be made under 500 volts pressure.

V. T. Delebecque, A.M.I.E.E.
British Electric Works Company, Limited.

June 15th, 1901.

Fuel and Smoke.

I read with pleasure your articles "Smoke Prevention" and "Fuel Economy."

The smoke given off by mechanical stokers appears to be small for the sole reason that it is being constantly emitted from the chimney. If the smoke thus given off were intermittent, like the smoke from hand-fired boilers, the smoke from mechanical stokers would appear much greater, and would, in some cases, be dense black smoke.

Firing by the coking system has one great drawback—it is almost impossible to get a stoker to take enough interest in this manner of firing to keep his fire-bars at the back of the fire thoroughly covered; he gets careless, and allows bare places on the bars; these allow the free passage of air, which may assist combustion of the smoke, but reduces the evaporating power of the fire.

From experience extending over a number of years, I have come to the conclusion that it is impossible to consume smoke by admission of air under the ordinary furnace bars, and to admit it, as is done, through gratings in the fire doors, or at the back of the fire, however efficient it may be, has the serious drawback that it is practically impossible to make an arrangement that would be so sensitive as to stop such admission of air, after the smoke ceases to be given off from the green coals after firing, and the stoker that would be so attentive as to shut off the air, when its admission only reduces the evaporating power of the fire, has yet to be trained. Another feature not mentioned in your article on "Fuel Economy" is the practice of coal-dealers offering so much per ton for what they call "burning money." This, I feel certain, is the cause of great waste of fuel in firing, and in some cases of dense black smoke. There are cases where it is not a question of obtaining the greatest benefit from the coals consumed, but the main point is to increase the weight of coals consumed and therefore the amount of "burning money" to receive.

In taking out my patent No. 21,616, 1899, I had one point in view, and that was to have an apparatus that would be a thorough smoke-consuming apparatus and require little attention. Without taking into consideration its water-gas production, its use would give an immense saving in fuel, for without the water-gas it would be as smokeless as a coke fire, and would in addition have the advantage of being a coal-gas fired furnace.

I consider the most practical way of burning smoke is to coke your fuel and drive off all gas, smoke and other condensable matter, and pass it through incandescent fire as secured by my patent.

I have sent on to the Patent Office to forward direct to you a copy of specification of my patent.

M. Campbell.

Management of Accumulators.

1. Which is most detrimental to accumulator plates, lime or other earthy material, or metals such as iron, zinc, &c.? Would ordinary town water be good enough for replenishing the cells?

2. I have a booster to enable charging the battery at the maximum voltage required (connected in series with the dynamo and cells). What would be the best way to ensure good regulation so as to charge at any particular regulating cell

at the correct voltage, with a variable current of from 20 to 50 amperes ?. At present I have too high a voltage when finishing charge (at an amperage of, say, 35) on the lower regulating cells. I may add that the system is three-wire of 210 v. outsides; the booster generator has an output of 70 v. 120 a. to charge a battery of 116 cells and capacity of 480 ampere-hours.

3. What are the signs, and are they serious, of the following conditions of the cells :—(*a*) Small white transparent cystals on plate above the electrolyte ; (*b*) a light brown sediment on the edges of plates, &c. ; (*c*) a white, damp, chalky-looking substance on the + plates above the electrolyte.

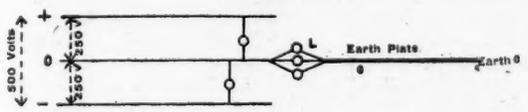
Electrique.

The Three-Wire System for Tramway Supply.

In reply to letter by "Silex" desiring information on the supply of electric energy to a tramway company by means of the three-wire system, using the rail as the middle conductor, I would like to point out some of the difficulties in balancing such a system. To do so I will first represent in a diagrammatic way a three-wire lighting system in perfect condition, and again the same system with one of the outers completely earthed through a fault of low resistance.

Diagram 1 represents the system in its normal condition. Here the mid-wire is connected to earth, not directly, but through a bank of 250-volt lamps. When the system is right, one of the outers is 250 volts negative to earth, the other is 250 volts positive to earth and the middle is at earth or zero potential. In this condition no current passes through the bank of lamps, L, as both terminals are at the same potential, viz , earth or zero potential. Suppose, however, that the negative conductor gets completely earthed, as shown in diagram 2, the mid-wire must change its position in its relation to earth if the potential difference is still to be maintained equal on both sides of it. But our mid-wire is not directly connected to earth. We must create a difference of potential between it and earth before any current passes through the lamps, L, to earth, and before these lamps attain their full candle-power there must be a difference of potential of 250 volts (in this case) between the mid and

Diagram 1.



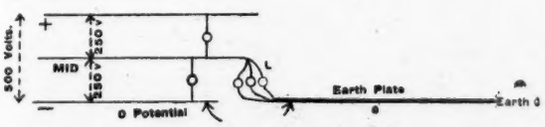


Diagram 2.

earth. Clearly, then, if we can create a difference of 250 volts between the mid and earth by merely adding a few more lamps, L, to the load we can easily maintain the balance equal on both sides, even although the outer wire is reduced to earth or zero potential.

The generators are now doing all their work positively to earth, the mid-wire is 250 volts positive to earth, and the positive lead is 500 volts positive to earth.

This I admit would throw an extra strain upon the whole system, but is infinitely better than having the total pressure, viz., 500 volts momentarily thrown upon the one side of the system only, as would be the case if the mid-wire was directly earthed.

I say momentarily, because such a state of matters could not exist, lamps would burst, fuses would blow, and probably damaged generators would be the result.

I have purposely taken an extreme case, but in a large three-wire system, no matter how carefully carried out, the mid-wire is continually varying between the perfect condition, diagram 1, and the other extreme, diagram 2. The lamps, L, in series with the mid and earth, are, in nearly all cases, of the same voltage as those in consumers' premises. This ensures a continuation of the supply, no matter how severe the fault, even although one or other of the outers is reduced to earth potential. There is no engineer who will allow such a condition of the system to exist for any length of time, but he cannot prevent it occurring occasionally.

In conclusion, I advise "Silex" that if he can get the Board of Trade to agree to allow him to insulate the rails, and he finds no other difficulties in doing so, his system will work ; but I am afraid, if not, he will meet with difficulties in maintaining the supply, and also in balancing.

J. C. Stewart,

Partickhill.

BUSINESS NOTES.

Application for Extension of Patent.—The Privy Council Judicial Committee will on July 24th hear a petition by S. Z. de Ferranti for an extension of patent No. 12,419, September 13th, 1887, entitled "Improvements in Electric Railways."

Bankruptcy Proceedings.—An application was made on Thursday to Mr. Registrar Hope at the London Bankruptcy Court for an order of discharge on behalf of Jacob Gutmann, known as Jacob Goodman, lately trading at 48, Commercial Street, E., as a dealer in electric fittings, &c., under the style of J. Goodman & Co. The Official Receiver reported that the failure occurred in September, 1898, the accounts showing ranking liabilities £3,850, and assets consisting of £4,000 shares in Goodman & Co., Limited, estimated as of uncertain productive value. Proofs had been lodged for £3,212 7s. 9d., and as there were further unproved debts for £897 14s. 11d., the actual ranking liabilities amounted to about £4,110. Nothing had been realised in respect of the estate. The bankrupt came from Germany in 1889, and was in employment until 1893, when, without any capital of his own, he began business at Broad Street Buildings, E.C., as the Victoria Lamp Maintenance Company. After trading for about 16 months he altered his style to J. Goodman & Co., electrical engineers. A little later he inherited about £500 from his father, and began to trade in gas and electric fittings. He removed his business first to 20, New Broad Street, E.C., and subsequently to Commercial Street, E., where he traded down to April, 1898, when he transferred the business to a private limited company. The business was insolvent at the date of such transfer. In the early part of 1898 the bankrupt found himself in difficulties; he communicated with his largest creditor, and it was after consultation with him that the company was formed. The bankrupt stated that this creditor agreed to take payment of his debt of about £1,600 in shares of the company, and he (bankrupt) hoped his other creditors would take debentures for their debts, or that he could raise money in debentures to pay them off. That scheme, however, proved unsuccessful, and the company eventually went into liquidation. The bankrupt attributed his failure to want of capital and losses in trading. He had admitted that he knew of his insolvency about the end of 1897, but nevertheless continued to trade and incur debts, and finally placed his assets entirely out of the reach of his creditors. As he valued the property transferred to the company at £1,500, it appeared probable that if the bankrupt had filed his petition or made an assignment for the benefit of his creditors at the time, and in lieu of the transfer to the company, the creditors would have received a dividend of 5s. in the £ or upwards. As offences the Official Receiver reported :—(*a*) Insufficiency of assets to pay 10s. in the £ to the creditors; (*b*) imperfect book-keeping; and (*c*) trading with knowledge of insolvency. Mr. J. Davis, who appeared for the debtor in support of the application, said his client was a very young man when he started, and he formed the business into a limited compauy after being advised to do so by his principal creditor. Immediately he found that the scheme was not a success, he placed himself unreservedly in the hands of his creditors, and filed his petition. The learned Registrar upheld the Official Receiver's report, and, having regard to the fact that the bankrupt had already been undischarged for nearly three years, he granted an order of discharge, subject to a further suspension of two years.

On Wednesday last week a receiving order was made at the Halifax County Court on the debtor's petition against Alfred Sharp, late of Barnsley, electrical engineer, now of Lane Head, Rastrick, near Halifax, out of business. The liabilities are about £160; assets *nil*.

Liquidation.—The following letter has been received from the liquidator of R. Waygood & Co., Limited :—

I have seen the notice under the heading of "Liquidation" which you have put in as to the meeting to be held by me on July 2nd next. Might I ask you please to note that this meeting is in consequence of the *reconstruction* of the business, and if you would not mind stating this in your next issue, I shall be very much obliged, because people will question this if they see our name under the heading of "Liquidation," and I am afraid they will take a serious and wrong view of the case.—For R. Waygood & Co., Limited (Vendor Company), D. W. R. Green, Liquidator.

Bills in the Commons.—In the Commons on Monday the Metropolitan Electric Supply Bill was read a third time. The Yorkshire Electric Power Bill was considered and ordered for third reading. The Metropolitan District Railway Bill was read a second time.

Electrical Wares Exported.

Week Ending June 12th, 1900.		Week ending June 11th, 1901.	
Adelaide	Value £150	Adelaide	Value £71
Alexandria	178	„ Teleg. wire	2,200
Amsterdam	83	Alexandria	48
Auckland	83	„ Teleg wire	43
Barcelona	280	Amsterdam	30
„ Teleg. wire	32	Archangel	239
Bombay	759	Bombay	315
Boulogne	16	„ Teleg. cable	82
Calcutta	407	Bremen	20
Cape Town	10	Buenos Ayres. Teleg. apprts.	277
Casa Blanca. Teleg. mat.	135	„ Teleg. wire	240
Copenhagen. Teleg. wire	71	Calcutta	1,060
Demerara	57	„ Teleg. mat.	22
Durban	437	Callao. Teleg. wire	46
„ Teleg. mat.	101	Cape Town	1,650
Emden. Teleg. apparatus	1,975	„ Teleg. mat.	1,307
Fremantle	27	Christiania. Teleg. wire	100
„ Teleg. wire	258	Colombo	179
Gibraltar	160	Copenhagen. Teleg. mat.	186
Halifax	70	Durban	946
Hamburg. Teleg. mat.	700	„ Teleg. cable	138
Hong Kong	335	East London	73
Mauritius	36	„ Teleg. mat.	1,127
Melbourne	1,792	Fremantle	12
Ostend	701	Flushing	39
Port Elizabeth	63	Gibraltar	15
Rouen	40	„ Elecl. instruments	700
St. Petersburg. Teleg. cable	52	Hobart. Teleph. cable	730
„ Teleg. cable	101	Hong Kong	12
Shanghai. 30 tons old teleg. wire	—	„ Teleg apparatus	23
Sydney	806	Malta	132
Vladivostock	145	Mauritius	20
Wellington	219	Melbourne	22
		„ Teleg. cable	1,308
		„ Telephones	47
		Montreal	100
		Nagasaki	40
		Penang. Teleg. mat.	40
		Port Elizabeth. Teleg. mat.	247
		Rangoon	57
		Rosario. Teleg. mat.	880
		Rotterdam. Teleg. mat.	391
		St. Petersburg. Teleg. mat.	500
		Shanghai	180
		Singapore	42
		„ Teleg. apparatus	407
		„ Teleg. mat.	41
		Stockholm. Teleg. wire	715
		Sydney	1 549
		Wellington. Telephones	1,650
		Yokohama	511
		Yokosaka	2,578
		„ Teleg. cables	3,754
Total ..	£10,234	Total ..	£26,640

Foreign Goods Transhipped.

Trinidad. Elec. apprts. Value £30 | Bombay. Elec. fans. Value £143

Electrical Wares Exported.

Week ending June 19th, 1900.		Week ending June 18th, 1901.	
Adelaide	Value £109	Adelaide	Value £55
Alexandria	24	Alexandria	1,616
Algoa Bay	66	Amsterdam	75
Amsterdam	43	Archangel	245
Archangel	861	Auckland	35
Auckland	206	Bangkok	215
Beira	597	Berbice	30
Bombay	256	Bilbao. Teleg. mat.	101
Boulogne	20	Boca. Teleg. mat.	390
Brisbane	283	Bombay	290
Brussels	86	Buenos Ayres. Teleg. cable	500
Buenos Ayres	2,205	Calais. Elec. detonators	50
Calcutta	918	Calcutta	861
Cape Town	306	Cape Town	1,032
Colombo	1,171	„ Teleg. cable	291
Copenhagen. Teleg. cable	137	Christchurch	67
Durban	260	Colombo	233
East London	101	Copenhagen. Teleg. wire	374
Hamburg. Teleg. mat.	1,200	Durban	499
Kingston	32	Fremantle	222
Lisbon	27	Hamburg. Teleg. mat.	300
Madras	18	„ Teleg. apprts.	482
Malta	825	Karachi Teleg. mat.	74
Mauritius	119	Launceston	76
Melbourne	293	Lisbon	75
Montreal	70	Lyttleton	16
Penang	150	Madras	115
Port Chalmers	49	Melbourne	328
Port Said	30	„ Teleg. wire	1,967
Rangoon	198	Ostend	29
Rio Janeiro	37	Otago	40
„ Teleg. mat.	1,369	Penang	40
Rouen	70	Port Chalmers	55
Shanghai	442	Port Elizabeth	460
Singapore	257	Quebec. Teleg. cable	153
Sourabaya	60	Rockhampton	300
Stockholm. Teleg. cable	207	St. Petersburg. Teleg. wire	45
„ Teleg. wire	275	Shanghai. Teleg. wire	40
Sydney	1,737	Singapore	61
Wellington	425	Stockholm. Teleg. wire	50
Yokohama	141	Sydney	538
		Wellington	220
Total ..	£15,989	Total ..	£12,544

Foreign Goods Transhipped.

Alexandria. Elec. mat.	Value £64	Fremantle. Elec. apprts.	Value £747
Bombay. Elec. mat.	12	Gothenburg. Elec. apprts.	25
		Hamburg. Elec. goods	60
		Perth. Elec. supplies	46
Total ..	£76	Total ..	£878

Catalogues and Lists.—Messrs. J. C. Lyell & Co. send us one of their latest illustrated catalogues of English made electrical accessories, cables, and also their new "Firefly" glow-lamps. These lamps are just being placed upon the market after years of experimenting.

Messrs. Ercole Marelli & Co., of Milan, have issued a list of electric motor fans of various descriptions.

Mr. J. Bernays, of Newgate Street, E.C., is circulating lists of improved patent centrifugal pumps.

Clarke's improved manhole covers for transformer stations, and ventilative covers for distributing boxes, are detailed in a new circular issued by the Mooregate Foundry and Engineering Company, of Featherstone Street, E.C. Castings and columns for street electric lighting and other similar purposes are also made by them.

Messrs. Holden & Brooke, Limited, have just issued a new list of steam traps or automatic drain cocks for discharging accumulated water from either high pressure or low pressure steam. Another list which accompanies it shows a variety of steam fittings and accessories manufactured at this firm's works at Manchester.

"Ferrofix," for brazing cast-iron, and "Borfix," a new flux for brazing any metals, form the subject of an illustrated circular issued by the manufacturers and patentees, Messrs. H. Bertram & Co., of 28, Queen Street, E.C.

The Brush Electrical Engineering Company, Limited, has brought out a new edition of the "Falcon Catalogue," in which many of the things turned out at the Falcon Works, Loughborough, are described. The list is largely taken up with steam locomotives, of which there are many designs shown; there is also a considerable showing of rolling stock, goods wagons, and steam tramway engines, also omnibuses and cars for horse traction. The catalogue is well and fully illustrated by means of photographs.

Messrs. R. W. Blackwell & Co., Limited, have issued a new list of flexible suspensions, guard-wire supports and clips, and earthing devices for telephone wires, also one of standard iron cocks.

False Pretences.—On Monday, at Westminster, a German engineer named Hans St. Lausnitz was sentenced to nine months' imprisonment in the second division for obtaining goods and electric fittings from various firms by false pretences. Among the firms mentioned were the Electrical Company and the Ediswan Company.

For Sale.—Particulars are given in our business pages of the plant which Messrs. Wheatley Kirk are to offer for sale by auction at Broadheath Engineering Works on July 9th and 10th, to which reference has already been made in these columns.

Foreign Electrical Imports.—Increasing quantities of foreign electrical material and apparatus are being imported into this country. The returns just issued for May show a total of £90,231, which compares with only £86,629 in the preceding month, and £78,350 in May, 1900. To the end of May last, the value of the imports have this year amounted to no less than £498,599 as contrasted with only £334,032 in the first five months of 1900.

Hope Jones Organ.—A new organ, on the Hope Jones electric system, has been erected in the Stockton Parish Church.

Ilford.—Although this station has only been running now a few weeks, Mr. W. C. C. Hawtayne, the consulting engineer, has already been instructed by the Council to make arrangements with Messrs. Veritys, Limited, for extension of street lighting.

Insulating Tape.—A new material for covering joints in insulated wires and cables is being placed on the market by the St. Helens Cable Co., Limited, under the name of "Dia's Patent Adhesive N Tape." It is made by a new process, in which a facing of pure Para rubber is applied to a prepared sheet of previously vulcanised rubber. The pure rubber side is put on next the wire, and thus, it is claimed, a vulcanised joint is formed without going to the trouble of a cure. We are not prepared to admit that a joint covered with vulcanised rubber tape is necessarily a vulcanised joint, or anything like it. However, we are informed that the insulation of joints covered in this way is as lasting as that of the cable, and that such joints, after several days' immersion in water, have shown an insulation resistance beyond the capacity of most delicate testing instruments to measure. Moreover, it is being largely used on the new Royal yacht. A rough trial which we have made shows that the tape possesses remarkable powers of adhesion, without the use of rubber solution, and we have no doubt but that it will be found very serviceable.

The Jones Underfeed Stokers.—We understand that these stokers are being employed in connection with installations working, and being installed, in England, France, Belgium, Holland, Russia, Norway, Sweden and Finland, although the American Blower Company only commenced to manufacture in England last autumn. We also learn that in connection with the equipment of Chicago University by Mr. John D. Rockefeller, the leading American stoker manufacturers competed. Mr. Rockefeller's engineer made an exhaustive investigation, with the result that all the 24 stokers adopted are of the Jones underfeed type.

Lacquer.—Messrs. Rhus & Co., Limited, of 149, Fenchurch Street, E.C. (also Liverpool and High Wycombe), are the manufacturers and vendors of patent Japanese lacquer intended for the preservation of structures of all descriptions, especially those of iron and steel. The lacquer is said to be easily applied, quite free from oil, and to be specially hard and durable, as well as being anti-corrosive and a preventative against oxidation or rust on metallic surfaces.

South African Electrical News.—The *B. & S. A. Export Gazette* says that the East London Town Council are considering a project for extending the electric tramway to the Jetty, at an estimated cost of £20,000. The acquisition of a specially constructed electric motor for the haulage of wool and general goods is likewise mooted. The Town Council have under consideration the placing of an order for an electric motor for tramway haulage pur-

poses. A concession has been granted to a Maritzburg syndicate to provide a public electric lighting installation for Dundee, Natal. The capacity of the plant will be equivalent to 1,000 16-c.p. lamps, and it is proposed to place the orders for the necessary machinery, &c., with as little delay as possible. The Durban Town Council are applying for powers to borrow £120,000 for the extension of the electric tramways, and £75,000 for electric lighting extension. The management of the Natal Government Railways have under consideration a larger employment of electric motors both in the machine and erecting shops, and for the working of traffic cranes, &c.

Three-phase Electric Driving.—The Electrical Company, Limited, have received an order from Messrs. Asa Lees and Co., Oldham, for one three-phase generator of 350 kw., and the necessary motors for driving their shops electrically.

The Tic-a-Toc Lubricator.—Messrs. Stern Bros., of Gracechurch Street, E.C., are just placing upon the market their new automatic Tic-a-Toc lubricator, which works on an entirely new principle. The action is simple. The throw of the crankpin, or eccentric, operates a pendulum, ratcheted to a worm-connected wheel, forcing the plunger—fast or slow as required—through the grease cup. It is stated that the ordinary engine, running 10 hours a day, at a speed of 150 revolutions a minute, will empty the pint cup in 11¾ days. Grease is forced into bearing in the exact quantity required, speed of engine or size of bearing being no obstacle. It is claimed that season or temperature will not interfere with the working of the lubricator if sterneline is used therein; the quantity of the lubricant is easily and surely regulated by increasing or diminishing

the swing of the pendulum, and if desired, the lubricator can also be operated as a hand-compression cup while the engine is running. The stem of the plunger extends through the top of the cup, and at all times indicates the amount of grease remaining in the cup. To get the best possible results, grooves should be cut into the boxes to allow the grease to be properly distributed. For use on eccentrics of engines which run continuously, or for a longer time than the cup will feed with one filling, a special attachment is provided. The lubricator is claimed to be specially suitable for crankpins, eccentrics, and other parts of machinery, for which an automatic lubricator which will force the grease slowly and constantly into the bearing, has been long required.

Trade Announcements.—The Electrical Maintenance and Accessories Syndicate have removed from Atlantic Chambers, 7, Brazennose Street, Manchester, to more extensive premises situate at 12, Peter Street, Manchester.

Messrs. W. Mackie & Co., notify that they have removed to 122 and 124, Golden Lane, E.C., so as to meet the requirements of extension of business.

The head office and works of the Non-flammable Wood and Fabrics Company, Limited, will in future be at Townmead Road, Fulham.

The D.P. Battery Company is, on June 24th, removing its registered offices from 66, Victoria Street, S.W., to 11, Victoria Street, S.W. The Lumford Mills, Bakewell, Derbyshire, having been extended, and nine acres of additional land purchased (making a total of 15 acres), the whole of the manufacturing will in future be concentrated at these works.

Turbo-Alternators.—Messrs. C. A. Parsons & Co. have sent us a photograph of the first turbo-alternator constructed by Messrs. Brown, Boveri & Co. under the Parsons patents. The plant is three-phase of 250 kw. capacity. Already about 12,000 kw. of turbine plants are on order, among these being one of 3,200 kw. for Frankfurt, and one of 3,000 kw. for Milan, and extensions to the new turbine shops at Baden are now in contemplation. The following list of steam turbo-generators on order will indicate how widely the advantages of the steam turbine are being recognised on the Continent:—For Frankfurt-on-Main, a 2,600-kw. single-phase and a 3,200-kw. three-phase machine; for Wild and Abegg, of Torino, a 250-kw. three-phase machine; for Berlin, a 100-kw. continuous set; for Tschopeln, a 360-kw. three-phase machine; for Milan, a 3,000-kw. three-phase set; also for Milan, a 2,000-kw. three-phase set, for which the turbine will be manufactured by C. A. Parsons & Co.; a 400-kw. three-phase plant for Aschenbornschacht; a 300-kw. single-phase set for Urfahr; a 280-kw. continuous machine for Marine Francaise; a 350-kw. three-phase set for Wordohl; for Troyes a 900-kw. three-phase set; and for Neuchatel a 300-kw. continuous machine.

ELECTRIC LIGHT AND POWER NOTES.

Brierfield.—The Tramways Committee recently obtained a report on the electric lighting of the district from Mr. A. G. Cooper, of Colne, and recommends the U.D.C. to carry out the undertaking.

Brighton.—The Board of Guardians has decided to adopt electric lighting for the workhouse, taking current from the Corporation's mains.

Carlisle.—The revenue of the electricity department has almost doubled during the year, and exceeds the working expenses by £788, but after allowing for the capital charges, there is a net loss on the year of £1,665. This is an improvement upon 1899—1900, however, when a net loss of £2,091 was shown. The demand for energy for tramway purposes is mainly accountable for the increased revenue. Private consumers took for lighting and motive power 116,737 units; the Tramways Company, whose cars were running during nine months of the last financial year, absorbed 176,699 units; for lighting public lamps, 67,304 units were used; and 76,684 units on the works.

Carnarvon.—The T.C. has decided to apply for a prov. order for electric lighting, Sir W. H. Preece having promised his gratuitous assistance as a freeman of the borough.

Chatham.—A deputation from the Council is to survey the company's electricity works with reference to the proposed purchase.

Chesterfield.—The T.C. has resolved to apply to the L.G.B. for leave to borrow £6,000 to carry out extensions of the electricity works.

Coventry.—The annual report of the electric light department states that the number of customers has increased from 226 to 331 during the year, and the lamps connected from 17,806 8-c.p. to 23,637. The number of units sold has increased from 229,607 to 341,810, and the revenue from £4,189 to £6,054. The profit on working is £1,539, against £787 last year. The capital charges amount to £3,790. The net charge on the rates is £2,251, against £1,745 last year. The amount of capital expended to date is £75,813.

Dumfries.—At the monthly meeting of the T.C. the E.L. Committee reported that they had found it impracticable to proceed with the water-power scheme according to the report of Mr. Ritchie, and it was agreed to communicate with Dr. Mond on the subject of the suitability of the Mond gas for electrical power, and to ask the B. of T. for an extension of time.

Dundee, Natal.—We read in the *British and South African Export Gazette* that a public meeting of ratepayers of Dundee have authorised the Town Council to accede to the application of Messrs. Swete & Lyster, on behalf of a Maritzburg syndicate, for the sole right of lighting the town by electricity. The limited liability syndicate, who will engineer the scheme, will have a capital of between £3,000 and £5,000, and purpose providing a plant to furnish the equivalent of 1,000 16-c.p. lamps, the 25 public lamps to be set up being of 50 c.p., and the private lamps ranging from 8 to 16 c.p. The generating station is to be erected near the railway station. This decision of the ratepayers disposes of the attempt of the Natal Acetylene Gas Company to secure the contract. This latter company have had several of their lamps on trial in the streets of the town for some time past, and it is said they contemplate setting up in Dundee a carbide manufactory, with the object of supplying the demand for carbide of calcium for the whole of Natal.

Failsworth.—The Council has decided to ask the B. of T. to extend the period for the completion of the works under the Failsworth prov. order for a period of two years from August 1st next.

Geelong.—The Electric Lighting and Traction Company of Australia, Limited, which has electric light works at Melbourne, Adelaide and Port Adelaide, opened its Geelong branch last month. The works cost £29,500, and contain Brush dynamos, capable of feeding 5,100 16-c.p. lamps, with 27 miles of overhead wires, and three miles of underground cables. The three-wire system is used for the first time in Victoria.

Hartlepool.—The E.L. Committee has decided to recommend the Council to adopt an electric lighting scheme to cost £18,000.

France.—Several projects are at present in course of realisation in the Corrèze district for the operation of central power stations by the aid of waterfalls, which are very numerous in the district. We understand that Mr. Lachèze, of Larche, who is at present occupied with a derivation project on the Vézère for the production of motive power to work a large hardware factory, has just acquired the Moulin des Escures, 5 kilometres higher up. By the aid of the powerful fall of this mill, he will be able to secure at low water a power of 500 H.P. It has been suggested that this energy might be utilised for the lighting of the town of Brive, which question is at present being seriously studied.

The works for the installation of electric lighting in Orléans have been commenced. The Compagnie Orléanaise du Gaz has treated for the earthworks and laying of the electric cables with M. Versillé, the contractor who executed part of the electric installations at the Paris Exhibition. The works are being pushed forward with all speed, and it is anticipated that the first part of the system will be in working order towards the beginning of November. The building of the power station, which is in the hands of M. Plumelle, is already finished.

The Société du Puits de Padirac has commenced the erection of works for an electric installation at Lot, destined to illuminate the Grottos of Padirac. The central power station is well forward, and it is expected that the installation will be finished at an early date.

Hove.—The T.C. has appointed Messrs. Handcock and Dykes to draw up the necessary plans, &c., for carrying out the Aldrington prov. order, for a fee of 200 guineas.

Hoylake.—The new generating station, to the opening of which we referred last week, stands on land adjoining the Wirral Railway. The building is of pressed red brick, and the entire structure rests upon a bed of concrete 12 in. thick, this concrete lying upon sand, which forms the surface stratum over the district, Hoylake being by the sea. The generating house is 50 × 33 ft., and is of ample capacity for convenient working and for additions. It contains four sets of machines. Three of these are placed along one side of the house, and are 125-H.P. Bellis and Morcom compound inverted, vertical, non-condensing engines, with 8-in. and 14-in. cylinders and 7-in. stroke. They will be run at 500 revolutions with steam at 150 lbs. initial pressure. Each engine is coupled direct to a 75-KW. 12-pole Crompton-Brunton patent alternator with an output of 33 amperes at 2,400 volts, the excitation at full load being 18 amperes 100 volts. There is also a motor-alternator which can be used for driving the direct current side to charge the batteries or excite the field magnets of the alternators, or the direct current side can be run as a motor, taking power from the storage batteries, and driving the alternator to supply light to the town at times of light load, during the day and after midnight. Either side of the motor-alternator will supply power for 400 16-C.P. lamps. In ordinary working the alternator would be run at 2,400 volts pressure for lighting, or if used to charge the storage batteries, the alternating side would be synchronised in parallel with the other alternators and the load be put on the coupled alternator, the voltage of this being increased until greater than that of the required charging current. Afterwards excitation will be done from the storage batteries or from the direct current side of the machine, but usually from the storage batteries. The generating house has been provided with an eight-ton hand-worked overhead travelling crane made by the Chatteris Ironworks Company. The crane has two lifts, one of 1 ton and the other of 8 tons. The switchboard is placed at one end of the generating house and has been fitted up by Messrs. Cowans, Limited. It is arranged for four engines and two main feeders. There are also two transformers, one connected with the bus bar and the other with the synchronising bar. Cowan's special switches, and charge and discharge indicators, and a shunt regulator with about 22 stops, have been fitted. There are two ampere-hour meters by Chamberlain & Hookham. The battery room adjoins the power house and contains two batteries of 60 cells each, which have been supplied by the Chloride Electric Storage Syndicate. The batteries will be worked in parallel and are of 27-plate, standard size, with 13 regulating cells. At normal discharge they will yield 100 amperes for five hours, with an emergency discharge of 300 amperes for one hour. The boiler house contains three hand-fired Lancashire boilers, each 28 ft. by 7 ft. 6 in. A Bailey superheater is connected with each boiler. A Green's economiser is installed. Two direct-acting vertical feed pumps of G. & J. Weir's make, are placed in a spacious separate apartment. A 7,500-gallon tank is also erected. The boiler supply will usually be taken from the store-tank, but there is a connection with the town main. The present area to be supplied with energy has a lineal extent of 2½ miles, but an extension of another 1½ miles is about to be made. There are now high-tension network mains of 8,600 yards, and low-tension distributing mains of 15,250 yards. Two feeders are provided between the generating station and sub-stations. One feeder, known as the West Kirby feeder, is 2,900 yards long and of ·15 square inch section. The other, the Hoylake feeder, is 750 yards long and of ·1 square inch. The high tension network mains are ·1 square inch and ·06 in. and ·04 in. respectively. The two-wire system is used, and there is a transformer at each of the sub-stations, and 12 other transformers in pits at different points over the area. The cables have been supplied by Callender's Cable and Construction Company, Limited. The present works have cost £27,000, and the District Council have applied for powers to borrow £13,500 for an immediate extension of the generating plant. The supply of electrical energy began at the Hoylake station on Whit Monday. The demand for energy up to the present time has exceeded anticipations; 75 applications have been received, representing 6,800 8-C.P. lamps. This includes street lighting, which will require 300 16-C.P. lamps. The local price of gas is 3s. 9d. per thousand. The charge for electricity will be 7d. per unit per hour for the first hour and 3d. per hour afterwards. So far, power for only one motor of ½-H.P. has been applied for; applications for radiators are, however, coming in somewhat freely. For the extension the Council have ordered another engine of 250 H.P., and an alternator. A continuous supply will be maintained at the station, with a supply pressure of 230 volts.

Hucknall Torkard.—The D.C. has decided to obtain a prov. order for electric lighting.

Inverness.—The T.C. is considering a project for generating electricity by water-power, and has instructed Mr. J. Frazer to draw up a scheme and report on the matter.

Keighley.—The municipal electricity installation was formally inaugurated on Saturday night by the Mayoress, in the presence of a number of members of the Town Council and friends. The works are built for an eventual capacity of 3,000 H.P. The Mayor proposed success to the new enterprise, and Mr. J. M. Smyth, the borough electrical engineer, showed the company over the works, which were carried out to his specifications at a cost of £30,400.

Keynsham.—The Parish Council has contracted with the electric lighting company for lighting the parish for the ensuing year at £188 10s.

Kingstown.—The U.D.C. has postponed further consideration of an electric lighting scheme until inquiries have been made as to the probability of having the scheme carried out by a private company.

Pontypridd.—The Guardians have decided in favour of lighting the Workhouse by electricity.

St. Helens.—The number of units sold for lighting last year was 211,000, and the quantity used for motors has advanced in the year from 24,000 units to 100,000. The consumption by the tramways company has advanced from 182,000 units to 593,000 in the last 12 months. The total consumption for the year was 910,000 units. The cost of production has been reduced from 4½d. per unit in 1898 to 1¼d.

Stepney.—The General Purposes and Staff Committee, after again going into the matter, last week recommended as follows:—

(*a*) (1) That Mr. A. Wright be appointed consulting electrical engineer to the Borough of Stepney, at a retaining fee of £800 per annum; (2) that Mr. Wright's agreement with the late Whitechapel Board of Works be cancelled; and (3) that Mr. Wright be required to enter into an agreement with the Council whereby his services will be secured at the remuneration above mentioned for a period of five years from February 14th, 1901. (*b*) That Mr. W. C. P. Tapper be appointed, during the pleasure of the Council, borough electrical engineer and manager of the electricity department at a commencing salary of £350 per annum, rising by annual increments of £25 per annum until £400 per annum is reached.

The recommendations were adopted.

Stockport.—A L.G.B. inquiry was held last week by Col. J. T. Marsh, R.E., into an application made by Stockport Corporation to borrow £5,175 for electric lighting.

Train Lighting in France.—The Eastern Railway Company, of France, is carrying out some experiments with the Vicarino train-lighting system, which was recently described in our columns. Each railway carriage has a small dynamo driven by frictional contact off one of the axles, an accumulator battery, and an automatic switch. When the carriage comes to a stop, the latter automatically connects the battery (which has a capacity of from 60 to 100 ampere-hours) up to the lamps. On the car restarting and attaining a sufficient speed, the switch automatically brings the dynamo into action again.

Wakefield.—The City Council has advanced the salary of the engineer, Mr. Blackmore, to £300 per annum, with a bonus of 1 per cent. on the capital cost of all extensions carried out by him.

Willesden.—The D.C. is negotiating with the B.I.W. Company, with a view to the latter carrying out the electric lighting scheme on the same lines as the Beckenham scheme.

ELECTRIC TRACTION NOTES.

Accrington.—A Blackburn paper says that it is rumoured that the British Electric Traction Company's agreement with the Accrington Tramways Company ceased some days ago. "The Accrington Corporation are therefore about to approach the Accrington Company with a suggestion to transfer to them that section of the tramway leading from Church to Clayton-le-Moors on terms which will be no loss to the company."

Austria.—A preliminary concession has been granted in respect of a projected light electric railway between Carlsbad and Elbogen.

Blackpool.—The Corporation appear to be having trouble over their new electric tramline to Marton. Since the route was opened there have been difficulties in working the line, which have led to inspections being made, and these have revealed a difference in the gauge on the track. In only five places, it is said, has the full standard gauge of 4 ft. 8½ in. been found, the gauge in more than 270 places being from ⅛ to ¼ in. less than the standard gauge. This is said to have been caused by a gauge being employed which was used when the promenade tramway was in service, and this gauge has been found to be $\frac{5}{16}$ in. less than the gauge of the car wheels. The Board of Trade have also prohibited the further use of the wide-grooved rail which was to be a feature of this Marton track. The objection to the rail has arisen through the many accidents which there have been to cyclists by their cycle tires becoming firmly set in the groove of the rail. Complaints were lodged with the Board of Trade, with the result that the further use of the wide-grooved rail has been prohibited.

Brentford.—That portion of the L.U.T. Bill relating to a tramway in Ealing Road has been withdrawn.

Canterbury to Whitstable.—Application is being made for a light railway order for the construction of light railways extending from Canterbury through Sturry and Calcott to Herne and Herne Bay, and from thence through Hampton and Swalecliff to Whitstable. It is proposed to provide cars which can be closed in winter, lighted by electricity, and constructed so as to be opened during warm weather.

Chatham.—The special committee of the Council has approved designs submitted by the Light Railway Company for poles and brackets for the electric tramway system. The committee asks that they shall be so fitted as to be suitable for electric lighting as well.

Glasgow.—A meeting of tramway conductors and motormen was held at Coplawhill at 1 a.m. on the 15th inst., when over 100 attended to discuss some grievances connected with the service.

At last week's sale of stud some 900 horses were disposed of, the average price obtained being about 16 guineas, as compared with 24 guineas some few weeks ago. There are over 2,000 horses still to be disposed of. This will be done as soon as the remaining electric routes are equipped and in working order.

What might have been an alarming accident occurred on the evening of the 12th inst., when the driver of an electric car lost control of his brakes going down Renfield Street. The car dashed into a horse car, causing the horses to trip and fall. Two ladies in jumping off the electric car were somewhat shaken. One of the Westinghouse rotaries in Dalhousie sub-station broke down on Friday evening and stopped the traffic for 20 minutes. An arc set up between a pair of the brushes on the D.C. side, and travelled to the frame of the machine, causing considerable damage to it. At a late hour on Saturday night, some damage was done to the overhead equipment on the Sandyford route. In shunting a car from one line of rails to the other for the return journey, the trolley pole became disengaged, there being no junction wire between the overhead conductors, and broke an overhead guard wire. The guard wire is earthed throughout the system, and on making contact with the live conductor a beautiful pyrotechnic display followed, some 200 yards of the guard wire being damaged. The two Allis-Thomson-Houston combined sets are now in working order, and of the whole system Kinning Park sub-station is the only one not yet working.

Greenwich.—The T.C. will not assent to the proposed scheme for a light railway between Woolwich and Eltham.

Heston—Isleworth.—The U.D.C. has appointed a special committee to report upon local stopping places as regards the L.U.T. Company's scheme. The Council has also referred to committee the proposed new light railway schemes of the County Council and the L.U.T. Co.

Light Railway Grants.—In reply to a question asked in the Commons last week, Mr. Gerald Balfour said that the Treasury had conditionally agreed to special advances under Sec. 5 of the Light Railways Act amounting to £197,250, of which £181,750 was by way of free grant, and £15,500 by way of loan. There remained, therefore, a sum of £52,750 available for special advances under that section. No loans had been granted under Sec. 4 of the Act, and the whole of the sum of £750,000 remained unappropriated.

Liverpool.—The Corporation accounts for last year have just been issued. They form a bulky volume. The amount expended in Liverpool on tramways capital account to the close of last year was £1,552,941, and the expenditure last year £449,481. The traffic receipts for the year were £416,604; this included £284,213 from electric cars, £102,177 from horse cars, £30,213 from omnibuses, and £5,012 from advertisements.

It has been decided to discontinue the Sheil Road inner belt car service, as the public have made little use of it, the route being well served by the cars of the main routes. The cars of the discontinued route will be put on two of the main routes.

Oldham.—On Saturday the Park Road, Glodwick Road and Lees Road section of the Oldham Corporation tramways were formerly declared open. These lines are part of the scheme for the construction of 25 miles of electric tramways within the borough, and the portions opened on Saturday are 2¾ miles in length. The energy for working the cars is supplied from the electric power station in Gas Street, though the erection of a new power generating station at Greenhill will shortly be commenced. For the present, three cars will deal with the traffic on these routes, but others will be run as they are supplied by the makers.

Progress in Electric Traction.—Electric railways originated in the United Kingdom, writes Sir W. H. Preece in the *Engineering Times*. How is it, then, that progress has been so slow? Because, says Sir William, the British financier has lost faith in electrical enterprises at home, and the electrical engineer has to look to Germany or the United States for capital. This, he says, is the cause of our national backwardness, and not either legislation or technical inability. We quite believe that great harm has been done by local authorities, whose attitude to traction schemes is one of greed and rapacity, with a view to bleeding promoters for the benefit of rates. Sir William says we are suffering for the financial fiasco of 20 years ago, which, by the way, was a lighting fiasco, and yet there is plenty of lighting. We are told that a steam locomotive requires 7 lbs. of coal to generate one horse-power-hour, but that in a modern up-to-date power-house, a horse-power-hour can be produced for 1½ lbs. of coal. Of course, this is a partial truth only, but it is only applicable to a steady load, and is not true for ordinary traction stations where the load is not steady. Electric traction has, however, advantages in the abolition of the locomotive and the use of the passengers' weight to give adhesion, so that an acceleration of 18 in. per second is possible in place of the ordinary 6 in. of the steam locomotive. Thus the 70 minutes' journey of the inner circle railway might be done in 50 minutes with electric traction. In connection with speed we are informed there will be no difficulty in obtaining 110 miles per hour on the Behr monorail system. Perhaps not, but where are the motors going to be put? Where is the difficulty in running at the same speed on an ordinary two-rail way? We should say it is less than in the 5-rail "monorail" way of Behr. There is so much that might be done in electrically-working our steam railways that it seems a little out of the way to risk electrical prospects on more or less speculative schemes. If it is estimated that the Metropolitan working expenses could be reduced 30 per cent. by means of electricity, we might all marvel that the directors in their wisdom did not earlier adopt it. Sir William is certain, however, that railway humanity will be staggered when the Metropolitan is electrified. Sir William condemns the third rail at rail level as dangerous. It should be above the train, and out of reach of the men on the permanent way—or of a passenger falling off the platform at a station. But a 500-volt conductor appears too large to place above the train, and 3,000 volts are recommended. Sir William says that the wattman, as it pleases him to call the driver, works all movements pneumatically, and is protected thereby from danger, while the passengers are safe under all circumstances. By the use of alternating currents, both generated and distributed at 3,000 volts, there is a minimum of machinery required; motors are simpler and more robust, and they can be attached so as to be wholly spring-borne. There would also be no electrical troubles as regards gas and water pipes. The economy of equipment would be 40 per cent. as compared with continuous current. The main objection to three-phase working is the three conductors required. The loss due to lag can be reduced by employing fine clearances, and these can be got by the use of modern machine tools. We cannot feel that the author is on such secure ground in claiming all he does for the Behr railway. We believe no satisfactory scheme of motors has yet been evolved, and the motors will be heavy and will add seriously to the stresses on the car framing, especially round curves. The "monorail" system will gain no advantage round curves, for it is a fact that ordinary trains every day run at such speeds round curves, that passengers are much inconvenienced, and we fear that, even if the Behr railway did run safely round sharper curves, passengers would suffer still more. Finally, he advocates end-entry cars, and quotes Major Cardew to the effect that double-track railroad could be equipped for £8,000 per mile complete; for £8,000,000, therefore, one might equip the N.W., S.W., G.N., and G.E. Railways electrically, and for another £3,000,000 throw in motor cars as well.

Richmond.—The T.C. has decided to take steps to secure the fulfilment of the L.U.T. Company's promises that the maximum local fare shall not exceed ½d. per mile, in view of the recent action at Chiswick.

Rochdale.—The engineer is to report on the car tenders received by the Tramways Committee. Car-shed plans have been approved. The first rail of the Norden section was to be laid yesterday.

Stirling.—Negotiations have been broken off between the Stirling and Bridge of Allan Tramways Company and the British Electric Traction Company, in consequence of the Town Council advising the company that they intend to purchase part of

the line within the burgh. A valuation of the lines is to be taken and negotiations opened with any company desirous of equipping the system.

Saddleworth.—The question of electric lighting and tramways has been discussed here. Messrs. Gibbings & Baker, who reported on the matter, stated that the estimated cost for lighting was £26,100, and tramways starting at junction going by Delph, Tamewater, Saddleworth station, Uppermill and Greenfield would cost £45,700, a total of £71,800. A Manchester firm of engineers offered to lay down a line from Delph through Uppermill to Greenfield, and from Leesbrook (Oldham boundary) over Lydgate. They would bear all expense, would take the profits or losses, and the system would be purchaseable by the Council at the end of 25 years. It was decided to write to other companies and obtain their terms.

Southampton.—The Tramways Committee has considered a letter received from Messrs. Kincaid, Waller & Manville relative to the claim of £96 by Messrs. Macartney, McElroy & Co., in respect of the delay in completing their contract, alleged to be occasioned by the work on other contracts not being sufficiently advanced to allow Messrs. Macartney & Co. to complete the several sections within the periods referred to in the general conditions of contract No. 5. The letter was referred to the deputy-chairman and town clerk. Twenty-six applications were received for the position of manager. The following candidates were invited to attend a meeting of the committee:—Mr. J. H. Cowell, 39, traffic manager and general superintendent, Blackburn Corporation Tramways; Mr. Edwin Edwards, 36, deputy-manager, Bradford Corporation Electric Tramways; Mr. Frank Hatch, 36, general manager, Wolverhampton and District Electric Tramways; and Mr. C. G. Simpson, chief inspector, Southampton Corporation Tramways.

Sunbury.—The U.D.C. has instructed the clerk to frame objections to the light railway schemes of the Middlesex County Council and the L.U.T. respectively, but the chairman has expressed the opinion that there will be no objection to the M.C.C. proposals if they will take over the roads concerned.

Surbiton.—The L.U.T. Co. has agreed with the U.D.C. to widen the Ewell and Ditton Roads to the full statutory width for tramway purposes.

Twickenham.—There was a breezy discussion at the meeting of the U.D.C., on 13th inst., as to the payment to the clerk of £150, and to the surveyor of £57 15s., for services in connection with the L.U.T. Company's Bill. These amounts have been passed by the company, but upon some imputations of dishonesty in the matter, the clerk apologised for not having brought the account before his committee, and the whole subject was referred back. The Council are dissenting from the light railway schemes of the Middlesex County Council and the L.U.T. Co. respectively.

Warrington.—An inquiry was held on 13th inst. with regard to the application of the Corporation for sanction to borrow £66,500 for tramway purposes. A statement of the estimated cost was given by Mr. Preece.

West Middlesex.—The estimated cost of the County Council's light railways for West Middlesex is £2,000,000.

TELEGRAPH AND TELEPHONE NOTES.

Consumption in the Post Office.—The question of consumption in the Post Office has been attracting some considerable public attention of late. We note that Sir Walter Foster, M.P., has evidently taken the matter up, and has given notice to ask a question which should go far towards putting the subject on a more scientific basis than has hitherto been the case. The terms of Sir Walter's question are as follows:—To ask the Secretary to the Treasury, as representing the Postmaster-General, whether, in view of the great scientific interest attaching to comparative statistics of mortality from phthisis, he will grant a return showing the mortality and superannuations from that disease in the Post Office, distinguishing between the various occupations, the outdoor and indoor staffs, London and the provinces, and the various ages of the employés?

French Cables.—It is announced that a submarine telegraph cable is about to be laid between Marseilles and Tangiers, Morocco, by the French Government.

Hull Telephones.—The Corporation Telephones (Special) Committee, on 13th inst., resolved to recommend the City Council to make application to the Postmaster-General for a license to establish a municipal telephone exchange to expire in 1911. It was further decided to approach the Post Office as to the terms on which they would be prepared to sell their telephone plant. The Town Clerk reported that in reply to the canvas, 854 persons were prepared to become subscribers for 1,029 instruments, and that the Local Government Board were prepared to sanction the borrowing of a loan for the purpose of establishing the exchange.

Kingston-on-Thames Telephones.—The T.C. has been informed that the Post Office telephone system will be working in the borough in the coming autumn.

New Military Telephone Apparatus.—A Swedish officer of fortifications, Herr Ernst Ljungman, has invented a most ingenious combined telephone and telegraph apparatus, principally for military purposes, which seems to answer all demands that may reasonably be made on such an instrument. In describing it, the leading Swedish organ, the *Svenska Dagblad*, points out that although in Sweden of late years electrotechnic science has made great progress in nearly all branches, hardly any development has been made with the telegraph-telephone service adopted several years ago. This may, perhaps, be due to the circumstance that the problem to be satisfactorily solved was almost an appalling one, *i.e.*, to combine in a single instrument the three sensitive parts composing the apparatus now in use in nearly all armies, which are so easily put out of order in the field, particularly when carried on horseback. The cardinal fault, however, of this apparatus is that it is composed of parts of an ordinary fixed telephone which are enclosed in a common case, so that in their construction no regard is paid to the special work required of them in the field when shifted from place to place. This drawback Lieut. Ljungman claims to have solved in his new apparatus, the invention of which has occupied him several years, and for which he has been receiving a State grant, whilst his progress has been watched by competent authorities. One of the great advantages of the Ljungman apparatus is its smallness, being, indeed, only the size of a half-a-pint bottle. In this small cylinder are enclosed the induction coil, the microphone with acoustic clock, and a strong battery. This is due to the fact that owing to the high oscillations of the telephonic vibrations, the battery and the induction coil do not occupy more space than the coil itself in other systems. The whole is enclosed in an iron cylinder, which protects the more delicate parts from external shocks, whilst at the same time increasing the electrical properties of the apparatus. Another new and important feature of the device is that the inventor has entirely discarded the ordinary vibrators and employs, instead, membrane vibrators of a new type, which admit of adjustments within limits which were impossible with the former. Moreover, every portion of the apparatus has been separately tested, as regards its electrical functions, under the conditions to which it may be exposed. The apparatus described is intended for the cavalry service, and has already been approved by the Swedish military authorities. But in addition, Lieut. Ljungman has constructed a pocket apparatus on the same lines, although not so serviceable, which weighs only 0·8 kilo., and is 13 centimetres in length and 6 centimetres in width, the principles being the same in all parts. Naturally, these portable telephone and telegraph apparatus may also be of great use in other than the military service, as, for instance, on railways, in the police and fire brigade services. A syndicate, the Elektromilitära Aktiebolog, of Stockholm, has been formed for the exploitation of the Ljungman apparatus.

Overhead Wires at Liverpool.—Since the fall of overhead telephone wires at Liverpool, during a snowstorm in February last, the local staff of the National Telephone Company have pressed on with the work of placing the wires underground. Within the last three months wires have been dealt with which have crossed the tramway trolley wires at 6,500 points, and have either been placed underground or close-run overhead, and rubber-covered in form of a cable, and suspended by steel wires with a large margin of strength. For these overhead cables 71 new poles have been erected. It is intended, however, that this overhead cabling shall only be temporary, and the wires will be put underground as the staff of the telephone company can deal with them. The Corporation of Liverpool, on their part, have increased the number of wooden guards above the copper trolley wires in places where contact by a broken telephone wire seemed possible, and have erected overhead guard wires where Post Office wires cross the tramway lines.

The Telephone Service.—In the House of Commons on Tuesday Mr. Austen Chamberlain, replying to Sir J. Woodhouse, said the expenditure already authorised by the Treasury under the provision of the Telegraph Act, 1899, for works in progress or about to be undertaken, amounted to £813,040. Of this amount £677,945 was for the London exchange system, and £135,095 for the development of the other parts of the Post Office telephone system in various places, but especially in the North-East of England and in South Wales. The actual payments for new works brought to account up to March 31st last amounted to £269,941. It was not possible at this stage to state definitely what the final cost of the London exchange system would be, but the whole sum of two millions authorised by Parliament would be expended in such extensions of the Post Office telephone system as seemed most urgently necessary, whether in London or elsewhere. The delay in opening the more important exchanges of the London system had been due to the scarcity of skilled labour, the difficulty of getting materials for contractors, the necessary restrictions on the opening of streets to avoid excessive interference with traffic, and the difficulty of constructing exchanges in buildings in use for other Post Office work. Full particulars of the rates and conditions of the service would be brought before the public at an early date, and it was hoped that it would be available in some parts of London in the autumn.

Telephones in South Africa.—At a recent meeting of the Simon's Town Municipal Council, the Mayor announced, in connection with a letter from the Postmaster-General, that Simon's Town was going to have telephonic communication with Cape Town.

Telegraphic Interruptions and Repairs :—

	CABLES.	INTERRUPTED.	REPAIRED.
Latakia-Cyprus		June 20, 1899	
Para-Maranham		March 1, 1900	
Gibraltar-Tangier		June 11, 1901	
	LANDLINES :—		
Bolama-Bissao		May 19, 1901	
Cayenne-Pinheiro		April 20, 1901	
Pekin-Kalgan		June 14, 1900	
Maimatchin-Kalgan		June 30, 1900	
Moulmein-Bangkok		June 18, 1901	

Wireless Telegraphy.—The Cunard steamer *Lucania*, which left Liverpool on Saturday afternoon for New York, carried a set of Marconi telegraphing apparatus. To work the system, a boom about 12 ft. long had been fixed near the top of the steamer's mainmast, the upper length of which is of wood, and from the boom a wire had been carried down to an operating room on deck, in which a Marconi transmitter and receiver had been placed. The first station off the American coast to receive messages from liners will probably be the Nantucket South Shoals Lightship, which is anchored 193 miles east of Sandy Hook and 43 from the shore. A set of Marconi apparatus has been placed on the lightship by the proprietors of the *New York Herald*.

Experiments with Marconi apparatus were carried out between the steamer *Lucania* and the school frigate *Conway* on the Mersey for some time before the liner's departure.

CONTRACTS OPEN AND CLOSED.

OPEN

Ashton-under-Lyne.—June 27th. The Corporation invites tenders for laying and bonding tramway rails, and for permanent way work. The Corporation provides rails, fishplates, soleplates, tie-bars, bolts and nuts, points, crossings and setts, and the contractor must provide all other materials, tools, labour, &c. Specifications, &c., at the office of Mr. J. T. Earnshaw, borough surveyor, Town Hall, on payment of £3 returnable as usual.

Belfast.—June 21st. The Corporation wants tenders for sinking an artesian well, and supplying pumping plant. See "Official Notices" June 7th.

Bermondsey.—July 1st. The Borough Council wants tenders for electricity meters, demand indicators, and main fuses. See "Official Notices" June 7th.

Birkenhead.—July 16th. The Corporation wants tenders for 15 electric car bodies, also equipments, trucks and trolleys. See "Official Notices" to-day.

Blackburn.—June 21st. The Council wants tenders for wrought-iron tubes and steam coal required during the next 12 months. See "Official Notices" June 14th.

Blackburn.—June 21st. Tenders for lubricating oils for the electricity works to be delivered at the Town Hall to-day, addressed to Chairman of Tramways Committee.

Bradford.—The Corporation is inviting tenders for the supply of 100 electric motor tramcars.

Bradford.—July 4th. The Corporation wants tenders for electric motors (enclosed) of 4½, 7, and 10 H P. See "Official Notices" to-day.

Brazil.—July 8th. The Foreign Secretary has received a despatch from H.M. Consul-General at Rio de Janeiro, stating that tenders are invited by the Brazilian Government, to be received not later than July 8th, for the supply of electrical machinery for the hoisting and transporting of locomotives at the Engenho de Dentro Works. Some particulars may be examined at the Commercial Department of the Foreign Office.

Brighton.—June 26th. The Council wants tenders for wiring the New Floral Market. Specifications, &c., from the borough engineer and surveyor (Mr. Francis May) Town Hall.

Cleckheaton.—June 22nd. The U.D.C. wants tenders for engines and dynamos. See "Official Notices" June 7th.

Darlington.—July 16th. "Free" or "assisted" wiring proposals are wanted by the E.L. Committee. See "Official Notices" to-day.

Dudley.—July 6th. The E. L. and T. Committee wants tenders for a steam engine and dynamo. See "Official Notices" to-day.

Epsom.—June 22nd. The Council wants tenders for D.C. meters and cut-outs. See "Official Notices" June 14th.

Erith.—June 24th. The U.D.C. wants tenders for Lancashire boilers, economiser, pumps, piping, condensing plant, steam alternators (high speed engines, three-phase alternators), switchboard, crane, transformers, sub-stations, mains and road work, arc lamps and posts, and station lighting. See "Official Notices" June 7th.

Exeter.—June 28th. The Council wants tenders for water-tube boilers, steam alternators, switchboards, coaling apparatus, tanks, &c. See "Official Notices" May 10th.

Great Yarmouth.—June 26th. Tenders are wanted for additions to the electric lighting station. Specifications can be seen at the Town Hall. Tenders to Town Clerk, Town Hall.

Italy.—June 30th. The municipal authorities of Pacentro (province of Aquila) are inviting tenders until the 30th inst. for the establishment of a central station in the town for public and private lighting purposes.

Leigh.—June 22nd. The Corporation wants tenders for electricity meters (12 months supply). See "Official Notices" June 14th.

Manchester.—July 1st. The Tramways Committee wants tenders for rail bonds. See "Official Notices" to-day.

Mansfield.—July 12th. The Corporation wants tenders for Lancashire boilers, stokers, pumps, economiser, 200-KW. steam generators, motor transformers, condensing plant, switchboard, battery, crane, mains, arc lighting, meters, and workshop equipment. See "Official Notices" June 7th.

Nelson.—June 25th. The Electricity Committee wants tenders for a travelling crane. See "Official Notices" June 14th.

Nelson.—July 1st. The Corporation wants tenders for steam engine and dynamo balancer, Lancashire boilers, pumps, economiser, condenser, piping, cables, and switchboard for electric lighting and traction. See "Official Notices" to-day.

Norway.—June 26th. The Norwegian State Railway authorities at Christiania are inviting tenders until the 26th inst. for the supply of 47 tons of galvanised iron wire, 12,800 porcelain insulators, and 9,000 insulator supports.

Poplar.—July 1st. The Electricity Committee wants tenders for condensing plant, feed pump, piping, &c. See "Official Notices" to-day.

Poplar.—July 2nd. The Electricity Committee wants tenders for multiple core lead-covered feeder and network cable and accessories. See "Official Notices" June 14th.

Spain.—June 24th. Tenders are being invited until the 24th inst., by the municipal authorities of Colmenar Viejo (Madrid province), for the concession for the electric lighting of the town during a period of 20 years. Tenders are to be sent to El Secretario del Ayuntamiento de Colmenar Viejo (Madrid), whence particulars may be obtained.

Spain.—June 25th. Tenders are being invited until the 25th inst. by the municipal authorities of Alcala de Quadaira (Seville province) for the concession for the electric lighting of the town during a period of 20 years. Tenders are to be sent to El Secretario del Ayuntamiento de Alcala de Quadaira (Seville), whence particulars may be obtained.

Stepney.—June 26th. The Electrical Committee wants tenders for "Conradty" arc lamp carbons for a year. See "Official Notices" June 14th.

West Ham.—June 25th. The Council wants tenders for three 500-KW. C.C. tramway-generators, and 850-I.H.P. steam engines; 11 water-tube boilers. See "Official Notices" June 7th.

West Hartlepool.—July 3rd. The Corporation wants tenders for single cables. See "Official Notices" to-day.

Whitehaven.—June 24th. The Corporation Lighting Committee is inviting tenders for the purchase of about 20 tons of second-hand rubber-covered cables. See "Official Notices" June 14th.

CLOSED.

Cape Town.—The Allgemeine Elektricitäts-Gesellschaft (London Agents, The Electrical Company, Limited), have received the contract from the Cape Town Government for the Table Bay Harbour plant, consisting of three 250-KW. direct current dynamos, coupled direct to Belliss & Morcom's engines; Davey, Paxman and Company's boilers; cranes from three tons up to eight tons carrying capacity, and 11 capstans. The mechanical part of the cranes is supplied by Messrs. Stothert & Pitt, Limited.

Dublin.—At a meeting of the E.L.C. last week, it was decided to report to the Council that they should accept tenders for the various sections as follows:—No. 4, £16,727; No. 5, £28,255; No. 6, £10,358, and No. 7, £5,225, or a total of £60,566. The total amount which the Corporation had sanctioned for the entire electric light installation amounts to £265,661, but this meeting concluded to place out tenders for the entire scheme at a sum of £246,189. The estimated amount of engineers' fees, &c., is £13,000, making £259,000 in all, or £6,000 under estimated amount. The tenders were as follows:—Specification 4, Section E (condensers), Alley & Maclellan, £3,020; Section F (pipework), Babcock and Wilcox, £4,805; Section G (feed pumps), D. Stewart & Co, £395; Section H (superheaters), Part 1, John Musgrave & Co., £832; Part 2, Babcock & Wilcox, £705; Section J (coaling plant), Graham, Morton & Co., Limited, £5,475; Section K (overhead crane), Carrick & Ritchie, £670; Section L (workshop plant), Easterbrook, Allcard & Co., £795. Specification 5, Section M (main switchboard), General Electric Company, £3,814; Section N (sub-station switchgear), Brush Electrical Engineering Company, £5,880; Section O (transformers), British Westinghouse Electric Company, £6,320; Section P (arc lamps), Veritys, Limited, £6,198; Section

Q (arc lamp pillars), Veritys, Limited, £6,042. Specification 6, Section R (motor and motor-generator), Witting Bros., £3,970; Section S (accumulators), Electric Power Storage Co., Limited, £751; Section T (meters), British Westinghouse Manufacturing Company, £4,670; Section W (works wiring), W. Coates and Sons, £967; Specification 7 (building 19 small sub-stations), the tender of Messrs. J. & W. Stewart, of Belfast, who are at present building the Pigeon House Electric Lighting Works, was recommended for acceptance, at £5,225.

France.—The French Post and Telegraph authorities in Paris have just given out the following contracts:—100 kilometres of copper wire (covered with gutta-percha and paraffined cotton), Messrs. G. & H. B. de La Mathe, of Gravelle St. Maurice, at 169½ francs per kilometre; 300 kilometres ditto, La Compagnie des Fils et Cables Electriques, of Paris, at 175 francs per kilometre; 200 kilometres ditto, La Société des Telephones, of Paris, at 177 francs per kilometre; and 200 kilometres ditto, M. Grammont, of Pont de Cheruy, at 179 francs per kilometre.

Kingston-on-Thames.—The T.C. has accepted the tender of Messrs. Johnson & Phillips for the supply of 1 mile of ·1 cable and half a mile of ·2 cable at £308 and £260 10s. respectively. The other tenders were:—

	1 mile of ·1 cable.			½-mile of ·2 cable.		
	£	s.	d.	£	s.	d.
Telegraph Manufacturing Company ..	338	0	0	283	0	0
Glover & Company	337	6	8	304	6	8
St. Helens Cable Company	326	6	8	282	6	8
Messrs. Siemens Bros., Limited ..	332	0	0	268	0	0
Henley's Telegraph Company	320	0	0	275	0	0

The Council has also purchased from Messrs. Siemens Bros., Ltd., a new arc light machine at £310, a spare armature at £176, and a new exciter panel at £72. The tenders of Messrs. Wm. Cory and Sons for 3,000 tons of Northumberland small coal, delivered by barge at Kingston at 10s. 5d., and of Crynant Collery Co., Ltd., for 500 tons smokeless steam coal at 20s. 3d., have been accepted.

Kirkcaldy.—On 10th inst. the T.C. adopted the recommendation of the Tramways and Electric Lighting Committee to accept the following tenders in connection with the electric lighting and tramway undertaking:—Messrs. Laurence, Scott & Co., for engines and dynamos, £6,620; a London company, for the storage battery, £1,364, with £80 of an annual charge for maintenance; Messrs. Carrick & Ritchie, for travelling crane, £370.

Perth.—Mr. Hawtayne has reported on the tenders for the wiring of the Municipal Buildings, &c., and the offer of Messrs. Pratt & Keith, Perth, which was the lowest, has been accepted. Messrs. Jones & Willis are to supply electric lighting fittings for the municipal buildings. One spare booster-armature, and a spare balancer-armature, are to be purchased from Messrs. D. Bruce Peebles and Co. The engineer has also been authorised to invite offers from three contractors for an improved battery regulator.

FORTHCOMING EVENTS.

Friday, June 28th.—5 p.m. At Wheatstone Laboratory, King's College, Physical Society Meeting. "The Effect of a a High Frequency Oscillatory Field on Electrical Resistance," by Mr. S. A. F. White; "The Spectrum of Cyanogen," by Mr. E. C. C. Baly and Dr. H. W. Syers.

NOTES.

The Incorporated Municipal Electrical Association.—The Glasgow meeting of the Association promised on Wednesday to be more largely attended than any previous gathering, although the papers to be read possessed no greater importance than those of former years. They are, indeed, fewer in number, and commendably short, as our readers have already gathered from our reference of the week before last. The Lord Provost of Glasgow met and welcomed members and visitors, who numbered nearly 200 souls, or, at any rate, bodies, and then the popular president, Mr. W. A. Chamen, delivered his presidential address—an address admirable in its terseness. Mr. Chamen is not the man to waste time in platitudes, and his business-like example may well be followed by future occupants of the presidential chair. A vote of thanks to Mr. Chamen was proposed by Mr. Alderman Bruce, of Sunderland, and enthusiastically received by everybody present.

Mr. Bailie Maclay, of Glasgow, then read his paper on "Street Electric Lighting." A discussion ensued, in which Bailie McKenzie (Edinburgh), Mr. Alderman Pearson (Bristol), Mr. Wordingham, Dr. Allfrey (Hastings), Mr. Newington (Edinburgh), Mr. Alderman Bence, Mr. Alderman Potter (Taunton), Bailie Finlay (Glasgow), who really brightened up the discussion, Mr. Tremlett Carter, and others took part; but nearly all the speakers were in accord with the paper in the main, and, practically speaking, there was little in it. The subject did not lend itself to much more than an interminable reiteration, on the part of nearly every speaker, of what had gone before. Plenty of energy was displayed, but it was not electrical; it partook more of the nature of a commodity which is sold at a few shillings per 1,000 C.F.

Mr. Rider was then called upon for his paper on "Uninsulated Returns in a Tramway System," but as the object he had in view had just been brought about by the Board of Trade, the reading of the paper was really anticipated, although this was not known at the time the paper was inserted in the programme. Mr. Wilmshurst commenced a discussion, which was carried on by Mr. Wordingham, Mr. Snell, Mr. Bromley Holmes (by a written communication), Mr. Minshall, Mr. Quin, Mr. Cooper, Mr. Turnbull, Mr. Tremlett Carter (who called the attention of the meeting to Mons. Claude's researches), and Mr. Sayers, when Mr. Rider replied to a very scrappy and desultory series of comments.

The party then adjourned to the City Chambers, where they were entertained at luncheon by the Lord Provost and Corporation. After an enjoyable repast, the usual loyal toasts were given, and then the Lord Provost gave "The Incorporated Municipal Electrical Association," to which Mr. Chamen suitably responded. The proceedings terminated with the toast of "The Lord Provost and Corporation of the City of Glasgow," and the members and visitors proceeded to carry out the afternoon programme, which consisted of visits to the Pinkston generating station of the Glasgow Corporation Tramways Department, the Dalhousie Street electric substation of the Glasgow Corporation Electricity Department, which contains a large number of transformers and rotary converters, and the Port Dundas generating station of the Glasgow Corporation Electricity Department, which contains over 8,000 I.H.P. of engines and dynamos of various makes and sizes, Babcock boilers working at 200-lb. pressure, with chain grate stokers and superheaters, special combined current and volt recorders for all the feeders, and several other features of interest; then to the annual dinner, held at the Windsor Hotel, and to which we shall refer next week.

Personal.—Mr. Nelson, who has completed his engagement with the Shanghai Municipal Council as manager of their electrical works, was recently honoured with a send-off dinner at the Astor House. Mr. Nelson's successor, Mr. Aldridge, had already arrived. Among the many Kungpu officials who graced the occasion with their presence were some of the obstructive bureaucrats who, we understand, have done their best to make the Corporation works a partial success only. It seems that Shanghai is by no means free from the troubles which characterise municipal control at home.

With reference to our last week's statement concerning Mr. L. P. Greig, he asks us to state that he was not assistant inspector of mains at Edinburgh, but simply assistant installation inspector under the superintendent of mains.

Mr. A. J. Ostler, of West Ham electricity works, has been appointed to the post of charge engineer at Bristol.

Mr. W. W. Alston, of the Bury Corporation electricity works, has secured the appointment of assistant electrical engineer at King's Lynn.

Mr. C. Carew Gibson has been appointed district superintendent of the County of London and Brush Provincial Electric Light Company's North London district. The appointment includes the control of the whole of the company's system of mains and sub-stations on the north side of the Thames.

Mr. O. M. Jonas, who has been seriously ill for some months, has resigned his position as electrical engineer to the Dewsbury Corporation. Mr. Jonas went to Dewsbury in May, 1898.

(*Continued on page* 1069.)

THE KENSINGTON AND THE NOTTING HILL COMPANIES' JOINT ELECTRICITY WORKS.

About two years ago the Kensington and Knightsbridge Electric Light Company, requiring a new generating station to meet the increasing demand in their district, and not finding a suitable site within their area of supply, decided to acquire land outside the area. A piece of land at Wood Lane, comprising about 13 acres, had

Wagon on Tipping Platform.

been purchased by the Kensington Vestry for use as a depôt, and the Vestry was approached on the question of selling a portion of this. About the same time, the Notting Hill Company was also looking out for a site for new works. The negotiations with the Vestry ended in a decision to erect joint generating works for the two companies, on part of the Vestry's land, and in due course, the Kensington and Notting Hill Electric Lighting Companies' Act, 1899, received the Royal Assent on July 13th, the companies being authorised to purchase the land and to erect and work generating stations, and to lay mains.

As the Wood Lane site is about 2½ miles away from the Kensington Company's district, and about 1 mile away from the Notting Hill Company's works, it was decided to adopt a high pressure system of supply, and the three-phase alternating current system was selected as the most suitable. The current is generated direct in the alternators at 5,250 volts, is distributed to each company's district by separate cables laid underground, and is converted to direct current by motor-generators in sub-stations.

The works are controlled by a committee of management, consisting of two directors of each company, and advised by the engineer of each company; the joint engineers are Messrs. H. W. Miller, M.I.C.E., M.I.E.E., of the Kensington and Knightsbridge E.L. Company, and G. Schultz, A.M.I.E.E., of the Notting Hill E.L. Company.

As soon as the Act was obtained the drawings of the new works were commenced. The design of the works, specifications and details of the machinery, the construction of the works and the erection of the plant, were undertaken by Mr. Miller, with the help of part of the staff of the Kensington Company, Mr. C. M. Bennett, who is now the resident engineer, and Mr. S. F. Weston, now assistant engineer, giving valuable assistance.

The land was acquired by September, 1899, and a road-way constructed to the site was soon available.

The excavations for the building foundations were commenced on December 17th, 1899, by men employed by the companies and under the direction of Mr. Bennett; in this way time was saved pending the placing of the building contract.

The work throughout has been carried on with great speed; so much so, that in spite of the usual delays caused by the various contractors, the first engine and alternator were used for testing cables on October 20th, 1900, and current was sent through to Kensington on October 23rd, only 10 months from the time when the ground was first excavated.

The following list gives the names of the directors and officials, and of the contractors for the work:—

Members of the Committee:—

Sir F. Bramwell, Bart.
R. W. Wallace, Esq., K.C. } K. and K.E.L. Co., Limited.
A. E. Franklin, Esq.
J. T. Jervis, Esq. } N.H.E.L. Co., Limited.

Joint Secretaries:—

R. S. Erskine, K. & K.E.L. Co., Limited.
R. G. Rawkins, N.H.E.L. Co., Limited.

Consulting Architect:—John Slater, Esq., F.R.I.B.A.

Clerk of Works:—A. Langton.

Contractors:—

Builders	J. Smith & Sons, Ltd., Sth. Norwood.
Boilers	Babcock & Wilcox, Limited, London.
Engines	Willans & Robinson, Limited, Rugby.
Alternators	Maschinenfabrik Oerlikon, Switzerland.
Exciters	Thos. Parker, Ltd.
Steam pipes	Stewart & Menzies, Ltd., Glasgow.
Pumps	Pulsometer Company, London.
Cranes	Marshall, Fleming & Jack, Motherwell.
Switchboards	O. Berend & Co., Limited, London.
Coal and ashes plant ...	Graham, Morton & Co., Ltd., Leeds.
Water tank	Stanton Ironworks, Nottingham.
Condensers and pipes ...	Korting Bros., London.
Steelwork	Dorman, Long & Co., Ltd., London.
Roofs	St. Pancras Iron Company, London.
Chimney	Myles & Warner, Stalybridge.
Railway plant	Kerr, Stuart & Co., Stoke-on-Trent.
Water softener	Doulton & Co., Limited, London.
Economisers	E. Green & Son, Ltd., Manchester.
Tipping platform ...	W. Renshaw & Co., Stoke-on-Trent.
Weigh bridge	W. & T. Avery, Limited, London.
Accumulators	Hart Accumulator Co., London.
Feed pipes, small steam pipes, &c. }	J. Aird, Great Bridge.
Valves	Templer & Ranoe, Coventry.
Electric motors	Bruce Peebles & Co. and J. H. Holmes & Co.
Excavations and concreting for foundations, cooling pond, flues, ashes tunnel, subway, &c. }	K. & N.H.E.L. Companies.

The area of the land acquired is 3¼ acres. It is situated in the parish of Hammersmith, and is bounded by, on the north, the Kensington Borough Council's depôt; on the south, the coal depôts of the G.W. and the L.N.W. Railways; on the east, the West London Railway; and on the west, the Central London Railway depôt. Access by road is provided from Wood Lane, and by rail from a siding into the works.

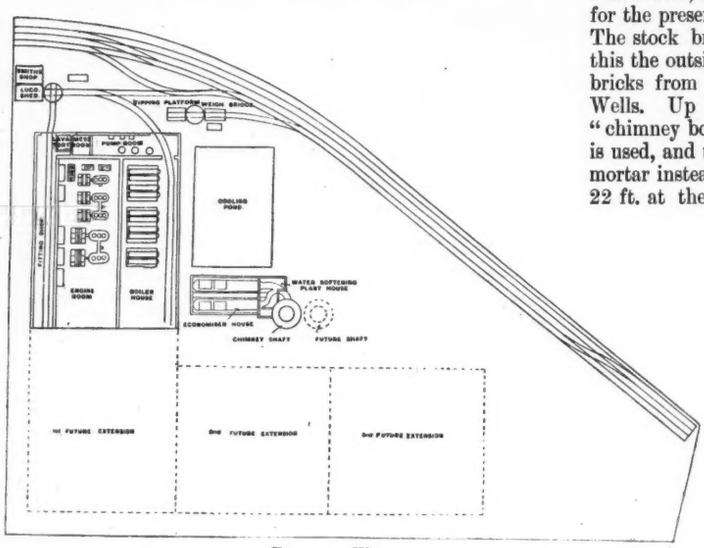
Cooling Pond.

G

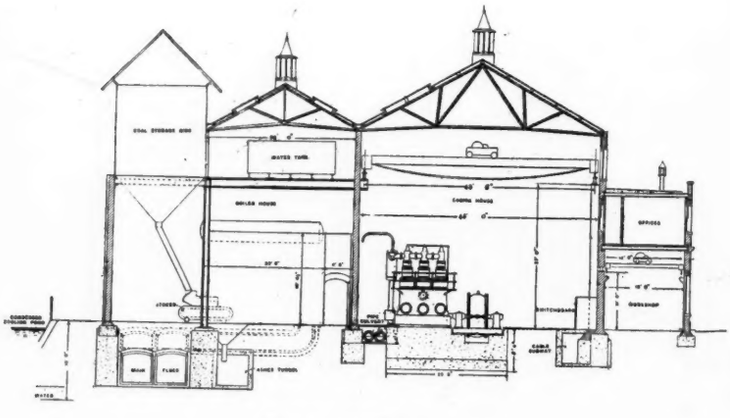
The site is large enough to accommodate 20,000 H.P. in two works, each containing 10,000 H.P., together with cooling ponds for the condensing water, two chimneys, economisers, and other out-buildings. The present building represents the first half of one of the two works, and is designed to contain plant for 5,000 H.P. The accompanying plan and cross-section show the general arrangement of the buildings and machinery, and the provision that has been made for future extensions.

The cost of the land, works, plant, Act, joint mains, and other expenses will amount to £100,000.

A single line from the railway enters the land of the Kensington Council; here it connects with two lines, provided for the joint use of the Council and the companies. On the companies' land the two main sidings have a length of 650 ft. each, and could accommodate 30 wagons on each.



PLAN OF WORKS.



SECTION OF WORKS.

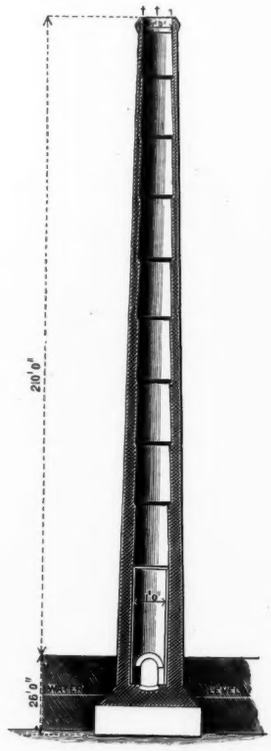
Secondary sidings of about 750 ft. run allow of shunting operations, for delivering machinery into the engine house and to the boiler house, and coal to the coal-handling plant.

The sidings are substantially built with standard railway plant and rails; the points and switches were made up by Messrs. Kerr, Stuart & Co., of Stoke-on-Trent, and were laid by the companies' men under the supervision of a foreman from the contractors. A small locomotive by Messrs. Kerr, Stuart & Co. is used for shunting; a locomotive house has been provided.

Twenty 10-tons capacity coal wagons have been purchased, each provided with one end door; these are taken one at a time, and passed over a weighbridge of 20 tons capacity, by Messrs. W. & T. Avery, Limited, on to a turntable, where they can be turned round if necessary, then on to a special tipping platform, shown in one of our views; the wagon is tipped up, the end door opened, and the contents shot into a steel receiver, the whole operation occupying a minimum of time and saving handling the coal.

The chimney has been designed to deal with the flue gases from boilers of 10,000 H.P. capacity, and is therefore large enough for the first works when extended to double the present size. It is 230 ft. high, and 210 ft. above the estate level. It is circular, and without ornamentation; the bore is 11 ft.

The excavation was taken down 26 ft. until the hard blue clay was reached, this depth being 13 ft. below the standing water level, so that pumping day and night had to be resorted to. A cement concrete block was then put in, measuring 36 ft. square × 10 ft. thick. On this foundation the footings were built, consisting of 28 rings of London stock bricks in blue lias lime mortar. The shaft commences at a depth of about 9 ft. below estate level, and is provided with two arched openings, one for the present boiler flues and one for the future extensions. The stock brickwork is carried up to the estate level; after this the outside courses are constructed with red radiating bricks from the Highbroome brick works, near Tunbridge Wells. Up to the height of 170 ft. above ground the "chimney bond" is used; above this "old English" bond is used, and the top 20 ft. of 14-in. work is built in cement mortar instead of lime. The outside diameter varies from 22 ft. at the bottom to 13 ft. 4 in. at the top. The fire-brick lining and air space extends to a height of 40 ft. from the bottom.



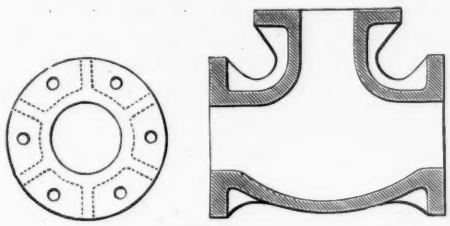
CHIMNEY SHAFT.

The cap is of terra-cotta, and is of special shape to deflect upwards the wind striking the cap, and thus to prevent the wind from beating down the gases coming out of the chimney. The good effect of this is very marked on the draught-gauge when a strong wind is blowing.

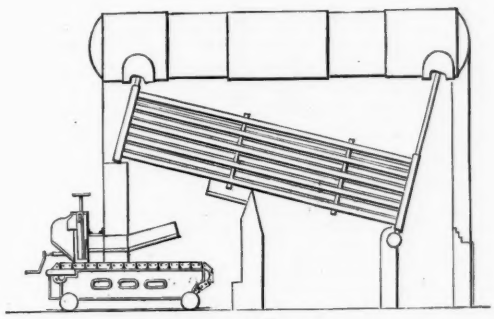
There is a notable departure from ordinary practice in this chimney—namely, that the bore is kept to 11 ft. throughout, and is not reduced by the firebrick lining, as occurs in all the examples of modern chimneys, the drawings of which were examined by Mr. Miller when designing this chimney. The cross-section above shows the effect of this at the point where the firebrick lining stops.

Work was started on October 23rd, 1899; the brickwork was commenced on January 29th, 1900, and was finished on September 19th, 1900.

The lightning conductor consists of two copper bands 1½ in. × ⅛ in., four copper earth-plates, and six gold-plated copper points with a copper ring round the top of the cap.



Cast-Steel Tees.



Section of Boiler.

Two sets of economisers have been provided in separate flues, with bypass flue between them. They are of the standard type made by Messrs. E. Green & Son, Limited, of Manchester and Wakefield, and there are 320 pipes in each. Space has been provided for doubling the number of pipes. The scrapers are driven by two electric motors.

A water-softening plant, by Messrs. Doulton & Co., of Lambeth, to treat continuously 1,500 gallons per hour, is fixed at the end of the economiser house. Water can be obtained either from the Grand Junction Water Company or by pumping from a well; for the latter purpose a 3-throw pump and electric motor is provided. Softened water to the amount of 200,000 gallons can be stored.

A cooling pond measuring 100 ft. × 60 ft. × 7 ft. deep has been excavated. The bottom is in a thick bed of clay; it has been lined with cement concrete and Callender's bitumen sheeting. Over the surface 84 of Messrs. Korting Bros.' jet fountains have been fixed, together with the necessary connecting pipes, valves and supports. The pond is large enough to deal continuously with the condensing water from about 2,500 H.P., and the water pipes have been put in large enough to suit when the pond is increased later on to twice its present size. The water is pumped to the fountains under a head of 15 ft.; one of our views shows the sprays in operation. The whole of the rain water collected on the roofs is delivered into the pond.

The boiler house measures 120 ft. long by 45 ft. wide; it will hold eight boilers, of which number five have been fixed. These are shown in the adjoining view.

The boilers, of Messrs. Babcock & Wilcox's manufacture, are suitable for a working pressure of 200 lbs. per sq. in. The heating surface is 3,654 sq. ft.; there are 162 tubes 4 in. in diameter by 18 ft. long, arranged in 18 sections nine tubes high, and two steam and water drums 4 ft. in diameter by 23 ft. long. Each boiler will evaporate 14,000 lbs. of water per hour.

The furnaces have been specially designed and patented by Mr. Miller to obtain smokeless combustion, and the results are quite satisfactory. The boiler tubes have been lifted up 3 ft. higher than usual, to form a proper firebrick-lined combustion chamber directly over the fire, and two firebrick arches are used instead of one. Further, the flameplate division wall between the furnace and the middle chamber has been moved nearer the front of the boiler, so as to raise the temperature and get more work done in the middle chamber; this also improves the second combustion chamber above the tubes, between the first and second chambers.

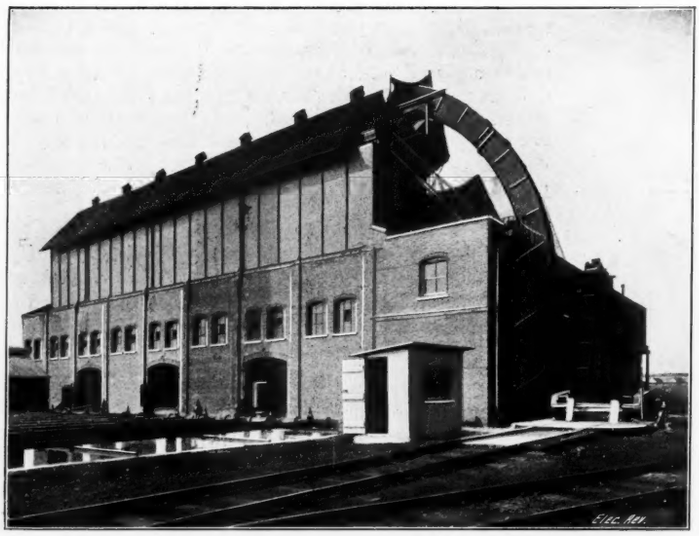
Chain grate stokers are used, having a grate area of 63 sq. ft. The coal hoppers and other details of the fronts of the boilers have been improved, as the result of experiments made on a similar boiler at one of the Kensington Company's works during the past 12 months; Mr. J. F. Jones, engineer of the Chapel Place station, suggested and designed these improvements. A 5-H.P. electric motor drives the shafting for the stoker gear.

The boiler house roof is constructed with non-flammable wood and steel, and is slated outside. Four large "Boyle" air-pump ventilators are fixed on the ridge of the roof.

The coal-handling plant designed by Mr. Miller, in conjunction with the contractors, Messrs. Graham, Morton & Co., of Leeds, is arranged so as to avoid touching the coal by hand labour, from the time it arrives on the railway sidings until it goes away again as ashes. After the coal wagon has been tipped, and the contents shot into a steel receiver hopper, the coal is taken through an automatic feeder at the bottom of the hopper into a bucket elevator, and lifted up to the

Water-Tube Boilers and Mechanical Stokers.

top of the building over the boiler house; it is then delivered on to a push-plate conveyor running the length of the boiler house, and over the steel storage tanks. By means of doors the coal is allowed to fall into any or all of these tanks. The capacity of the seven tanks is 875 tons, giving about 30 days' storage for each boiler.



Exterior of Works.

At the bottom of each tank is an outlet, fitted with a shoot leading into the hoppers of the chain grate stokers. This shoot is of special patented design, and contains an adjustable measuring chamber, with double slide doors, to pass 4 cwt. of coal at a time; also the whole shoot is hinged near the top, so that it can be swung out of the way when the boiler tubes are being cleaned.

The whole plant will deal with 30 tons of coal per hour, and is designed to suit the second half of the works when this is built. Two 10-h.p. electric motors drive the elevator and conveyor.

After the coal has passed through the furnace and been consumed, the ashes and clinker formed are carried over the end of the chain grate and fall into a pit, then down a shoot having a door at the bottom, and are discharged into the ashes conveyor, which is situated in a tunnel formed under the boilers. The ashes are carried by the conveyor to an elevator and discharged into a storage tank, from which they are emptied into a railway wagon or cart as required. The ash conveyor and elevator are both driven by one 15-h.p. motor. Some of our views show parts of the coal-handling apparatus, and a full illustrated description will be found on page 326 of the present volume.

Two main flues have been constructed under the boiler house floor; the branch flue from each boiler is taken into one or other of these. Each pair of boilers is connected to alternate flues, so that one of the flues can be cleaned whilst the other one is in use.

The feed pipes are of lap-welded steel and iron, with flanges forged on solid, also some have screwed-on flanges; these were made partly by Messrs. Stewart & Menzies and partly by Mr. Joseph Aird.

A 5-in. bore pipe is taken from the pumps to the economisers, and the return is by two 4-in. bore pipes running the length of the boilers, with a branch off each pipe to each boiler. There is also a by-pass pipe direct from the pumps to the boilers. The suctions and deliveries are in duplicate. All tee-pieces have been specially designed by Mr. Miller to reduce obstruction to the flow of water and to prevent shock to the pipes; as shown in the section on p. 1067, the area is considerably increased and the corners rounded off.

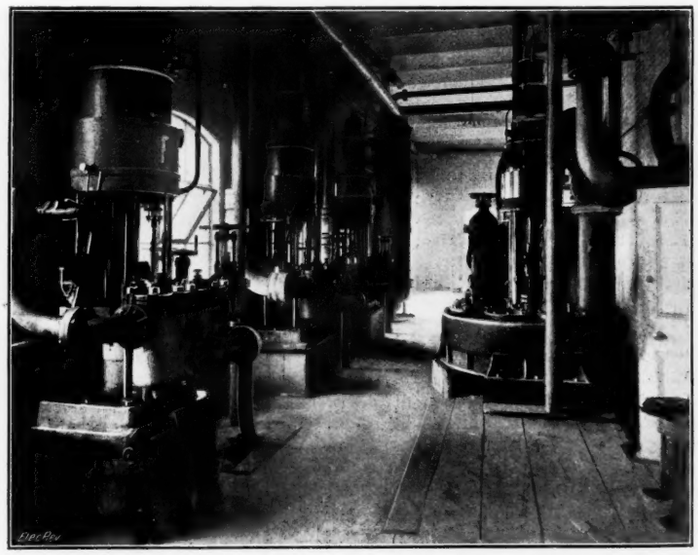
Over the boilers two cast-iron tanks are fixed, which measure 112 ft. long × 16 ft. wide × 6 ft. deep, and will hold about 55,000 gallons of water. These tanks give the necessary head of water required by the Korting ejector condensers fixed on the engines. The tanks are filled by one of the circulating pumps, the steam valve on the pump being controlled by a float in the tank. At the time of full load on all the engines the tanks contain half an hour's supply, allowing ample time for starting up a spare pump should an accident occur to the one in use.

The pump room, situated next to the boiler house, contains six pumps, made by the Pulsometer Engineering Company, of Nine Elms, London, S.W. They are all direct-acting, compound steam-driven, and exhaust into two feed-water heaters.

Three of the pumps are for boiler feeding against 200 lbs. pressure, and have a capacity of 4,000 gallons per hour each. The other three are for low pressure service, dealing, one with the circulating, and one with the cooling water; the third pump is common to both services and is a spare. The capacity of each pump is 100,000 gallons per hour, and the head of water to pump against is about 20 ft.

Steam is supplied through a ring main connected both with the boilers direct and with the engine house main pipe.

The steam pipes are of lap-welded steel, with iron flanges welded on solid with the pipe; the tee-pieces are of wrought-steel rivetted to the pipes. The sizes of the pipes have been kept as small as possible, being calculated to allow of a drop of steam pressure of 1 lb. per sq. in. per 100 ft. run. There is only one main pipe, of 7-in. bore, this being in the engine house; branches from the boilers are 5-in. bore and branches to the engines are 4-in. and 5-in. bore. The length of the pipes has been kept as short as possible. Sectional valves of Messrs. Templer & Ranoe's make, with steel bodies, are provided for dividing up the boilers and engines. A 3-in. bore pipe in the boiler house, with branches to each boiler, provides an auxiliary service to the steam pumps. The boiler stop valves are also non-return valves, of Templer & Ranoe's make. The boiler blow-off pipes have double (concentric) plug cocks and non-return valves



Circulating and Feed Pumps.

of Dewrance's make, the latter being to Mr. Miller's design. The steam pipes are covered with Messrs. Snowdon's special asbestos pipe covering, 2 in. thick, this material having come out best at a series of trials made by Mr. Miller on various coverings. Thermoscopic loop steam traps, with Delta metal valves and seats, are used in the steam ranges.

(To be continued.)

NOTES.

(Continued from page 1064.)

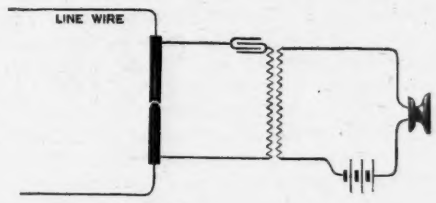
The Swansea Contracts.—As we go to press the following communication comes to hand from the International Electrical Engineering Company, of Clun House, W.C.:—

I am surprised to see a note in your last week's issue in which Mr. Cawthra criticises Messrs. Kincaid, Waller & Manville's recommendation of my firm's tender. I hasten to inform you that all our machines are provided with bolts and screws in accordance with Whitworth standard gauge. Our machinery has been at work in the leading iron and steel works, shipbuilding yards, &c., in this country for the last 10 years); in fact, we believe we can claim to have supplied plant to more works of this character in the United Kingdom than any other firm, and no question has ever arisen with regard to our methods of manufacture or the quality of the machinery. Regarding spares, &c., we hold in London a stock of brushes, brush-holders and such like parts which are likely to be wanted at short notice. In any case, our works are only about as far from London as Swansea is, and we are a unique firm, in that we manufacture every part of the plant ourselves, and so are quite independent of others for supplies. To show how our manufactures are appreciated, we may mention that we have now in hand important contracts for the Corporations of Hull, Bray, Bristol, Dundee, Colne, &c., besides a complete three-phase transmission plant for the British Xylonite Company, and smaller contracts too numerous to mention. We are especially expert in the class of apparatus required for Swansea, and the fact that we gave the fullest information and good drawings to the consulting engineers, no doubt weighed greatly in our favour. We make switchboards with the apparatus at the back in the ordinary way, or with all apparatus and connections at front on the cubicle or pigeon-hole plan. Some engineers like them one way, and some another—it is immaterial to us, which way we build the boards.—For the International Electrical Engineering Company, E. Kilburn Scott, engineer and manager for United Kingdom and Colonies.

Street Opening.—In the House of Commons, on 13th inst., Sir H. Vincent asked the Secretary for the Home Department if he had observed the inconvenience and loss of time and money to which the people of London were subjected by the way in which numerous authorities in the same area resorted to the consecutive taking up of the most frequented streets. Could he state how many London authorities had this privilege for gas and electric lighting, telephonic and telegraphic communication, paving, drainage, water supply for domestic use and hydraulic power, and other purposes; and would he consider the possibility of bringing all these bodies and companies under one licensing head which should have control of the taking up of the streets? Mr. Ritchie, in reply, said that he was unable to give figures, but the number of bodies, both local authorities and trading companies, who had obtained from Parliament powers of breaking up the streets was large, and he agreed that very considerable inconvenience often resulted from the exercise of these powers. Recently, of course, the evil had been aggravated by the operations on behalf of the Post Office in connection with telephones, which were, he hoped, drawing to a conclusion. He would be very glad if any remedy could be found; but, so far, he was afraid that he had not seen any proposal that would be practicable and meet the case.

Appointments Vacant.—A shift engineer is required for the Walsall electricity works. An assistant teacher of electrical engineering is required for the Bolton Technical School at £120 per annum. A second assistant of mains (£100 per annum) is wanted for Edinburgh. The Wellington (New Zealand) Council wants an electrical engineer with tramways experience. The Committee of the Manchester School of Technology will shortly require a head of the physics and electrical engineering department at £500 per annum. A shift engineer at £100 per annum is required for the Huddersfield tramways power station. See "Official Notices" to-day.

A Whistling Arc.—Mr. Frank C. Daniel states in the *Scientific American* that "some very interesting experiments have been recently performed at Dickinson College by Mr. Charles C. Dunning on the effect of rapid variations in the current of a direct-current arc. In December last it was demonstrated by Mr. W. Duddell, before the Institute of Electrical Engineers, that when the current of an arc varied, a contraction or expansion of the vapour column resulted. When the variations were sufficiently rapid, musical notes and articulate speech could be produced. To demonstrate this interesting phenomenon, Mr. Dunning used an ordinary arc lamp furnished with a current of 10 amperes. The arc



was shunted through a one-third M.F. condenser and the secondary coil of a telephone transmitter. The primary coil was placed in circuit with a transmitter and a storage battery of two cells. The above diagram will show the connections. The transmitter was placed in a distant part of the building. When the arc was lighted and a tuning-fork was held in front of the transmitter, the note was reproduced by the arc. The best results were obtained by whistling into the transmitter. By this means the arc was made to whistle a tune, which it did perfectly, reproducing every note loud enough to be heard at a distance of 20 or 30 ft. When the transmitter was spoken into, sounds were produced by the arc, but it was difficult to distinguish any words. The experiment is easily performed, and is very well adapted to the lecture table." The above arrangement is very similar to that used by Mr. Duddell.

Name and Fame.—The United States now boasts its Hall of Fame. The building is the gift of Miss Helen Gould, is erected at the University of New York, and has cost about £20,000. Its purpose is described by a trans-Atlantic exchange as being "intended to contain memorial tablets and busts of great Americans, and the selections are made by vote, the electors being themselves a chosen few, leaders in every department of intellectual activity." There are only 29 names now on the bronze tablets, each of which measures 10 ft. long × 1 ft. high; but it is stipulated under the terms of the gift that 150 names are to be honoured by the year 2,000. The *Electrical World* is not slow to boast that every name now on the tablets is a worthy one, which, "*of course*, is more than can be said of the 'immortals' distinguished in Westminster Abbey, St. Paul's Cathedral," and other places which our esteemed contemporary names. But why "Of course?" We wonder how many of the "immortal" 29 "Americans" were of English or European extraction? Surely our *confrères* have not formed a trust covering worthy names? Their present capacity for "breeding" (we use the New York writer's own term) men of real worth is not overwhelmingly great. They must, however, turn out 121 within the next 99 years.

A Stoppage at Rheinfelden.—The huge water-power-driven electric power station at Rheinfelden was brought to a stand a few days ago owing to a curious and unusual cause. After a long period of dry weather sudden storms occurred in the Foehn Mountains, and before the hydrometric service of the station could take the necessary precautions, the water flowed along in torrents to the station. With the water came large quantities of branches, dead wood, and leaves, which were caught by the screens at the mouth of the conduits leading to the turbines. So great was the collection that it quite closed the screens, and the water quickly rose to a height of over 6 ft. There was no help for it but to stop the turbines and lower the water-gates to permit of the screens being cleared of the blocking leaves and branches.

The Steel Trust.—Reuter's agent at Philadelphia quotes the *North American* as saying:—"British capitalists have come to America with a view to buying up all good steel companies outside the Morgan Steel Trust. They may hold and work the plants, resell one or all of them, or merge the companies into a second Steel Trust in opposition to the United States Corporation."

Wireless Telegraphy in the Navy.—The introduction of wireless telegraphy in the Navy has created a new want in the shape of specially trained telegraphists. At present these operations are carried out under the supervision of the torpedo lieutenant, who almost invariably is present during the transmission of signals, if he does not actually work the key himself. Signalmen in the Navy go through a course of ordinary telegraphy, and are familiar with the circuits used in connection with the Morse key and sounder, but they are not electricians, and very many of them simply learn to make the connections by rule of thumb, understanding little or nothing about the construction of the various instruments they use. Some of the parts of the wireless telegraphic apparatus are very delicate and require exceedingly fine adjustment, so that it is hardly fair to expect a man who has been used to bending on flags, and working semaphore arms and stoutly constructed flashing lamps at great speed, to treat the wireless instruments with the same respect as if he had been trained to that sort of work. The present staff of signalmen is by no means too large for a ship with the fleet, especially during manœuvres, when a continuous stream of signals is passing through their hands, and when a slight mistake may throw the squadron into confusion. Speed, accuracy, and a thorough knowledge of the signal books is what is wanted on the bridge, and for this a very thorough training is necessary, so that the signal branch of the service has quite enough to do in keeping itself efficient, without making additions down below in the telegraph room, where the receiving instruments record the dots and dashes upon a strip of paper; and where it is necessary to work the key slowly and distinctly, the knowledge of the signalman is a minor detail. Anyone can be taught to make and receive Morse signals fairly slowly in a week or so, and the accuracy of long-distance signals cannot be of such immediate importance as those performed on the bridge, where a signal to alter course wrongly interpreted, may result in a collision. What is really wanted in the telegraph room is a thorough knowledge of electricity and its behaviour, and a certain amount of mechanical skill for making repairs and adjustments. If the torpedo officer can rely upon the technical knowledge of the telegraphist on watch at the wireless telegraph to some appreciable extent, he is far more free to attend to his other duties, and exercise a general supervision over the whole. Wireless telegraphy is at present only in its infancy, but it promises to take a very prominent part in the Navy, and once the problem of tuning out all other stations but the one called up is solved, there is little doubt that a special staff of men will be carried in each ship, whose duty it will be to attend solely to the wireless telegraphic system.

Marriages.—Mr. J. B. Braithwaite, jun., was married on June 15th at the Friend's Meeting House, Harlesden Lane, N.W., to Margaret Grace Moscrip, of Morebattle, Kelso, N.B.

At Christ Church, Woking, on the 4th inst., Mr. Jas. Geo. McLean, manager of the Woking Electricity Company, was married to Miss C. L. Battrick, second daughter of Wm. Battrick, Esq., of Woking. The company's staff and employés presented the groom with two handsome wedding gifts.

Central Technical College Old Students' Association.—The fourth annual dinner of the Association of Old Students of the Central Technical College will be held at the Restaurant Frascati, Oxford Street, on Wednesday, July 3rd, at 7.30 p.m. Prof. O. Henrici, F.R.S., President of the Association, will take the chair. Tickets (price 6s.) can be obtained on application to the hon. secretary, Mr. Maurice Solomon, 12, Edith Road, West Kensington, W.

Lightning Conductors.—The Electrotechnischer Verein of Berlin, have issued a series of regulations for the protection of buildings from lightning. When the subject was discussed before the Society there was found to be a great difference of opinion on many of the rules proposed by the committee, with the result that the residue on which all the members were agreed, contained little that was not already generally known and accepted. The only novel idea which they appear to have adopted, was a suggestion of Herr Findeisen, that the structural metal work of buildings might be used to replace, in whole, or in part, the special metal conductors, usually affixed to buildings by the lightning rod man. The adoption of this principle would lead in many cases to a considerable reduction of the cost of protecting buildings against lightning. The Society recommends the multiplication both of the upper terminals, and the earth plates in the case of large buildings. That follows from the lateral repulsion of varying currents, and has, we believe, been recommended before. Sub-divided conductors of iron should be not less than 50 mm² in section, and when solid, not less than 100 mm². For copper, half these sections is sufficient; for zinc, one and a half; and for lead, four times. All joints in conductors should have as large a surface as possible; if not welded or soldered, the contact surface should be not less than 10 cm². To keep conductors efficient, they should be frequently inspected by an expert; it should not be forgotten to note whether changes made in the buildings require corresponding modifications in the arrangement of the conductors.

Standardising Iron and Steel Sections.—A committee has recently been appointed by the Institution of Civil Engineers, with the support of the Institution of Mechanical Engineers and Naval Architects, and of the Iron and Steel Institute, to consider the advisability of standardising the various kinds of iron and steel sections, and if found advisable, then to consider and report as to the steps which should be taken to carry such standardisation into practice. The committee is composed as follows:—Mr. James Mansergh, Pres.Inst.C.E., Sir Benjamin Baker, K.C.M.G., Sir John Wolfe Barry, K.C.B., Sir Frederick Bramwell, Bart., Sir Douglas Fox, Mr. G. Ainsworth, Mr. William Dean, Mr. A. Denny, Mr. J. Allen McDonald, Mr. E. Windsor Richards, Mr. James Riley, Prof. W. C. Unwin, F.R.S., and Dr. J. H. T. Tudsbery (hon. secretary). Mr. Leslie S. Robertson, M.Inst.C.E., of 28, Victoria Street, S.W., has been appointed secretary to this committee, which has already commenced its work by taking evidence tendered by engineers, manufacturers and contractors, bearing upon the subject of the inquiry.

A 10,000-volt Shock.—Our New York namesake records in the last issue to hand that "on May 30th, at Hartford, Ct., a nine-year-old boy, named Arthur Budds, got hold of the transmission-line cables which bring in power for the electric light company in that city at a pressure of 10,000 volts alternating (60 cycles) and received a tremendous shock, sufficient to burn his hands very severely and to render him apparently dead when he was finally rescued. After working over him for some time with artificial respiration he regained consciousness and began to breathe naturally. He is progressing steadily toward complete recovery." Our contemporary adds:—"It will be noted that he got a shock over five times as powerful as that which is used in this State for the execution of grown-up criminals. Comment further is entirely unnecessary."

Electric Motor Car Run.—A long distance run was accomplished by an electrical vehicle belonging to the British and Foreign Electrical Vehicle Company, Limited, on Tuesday last week. The car employed is a large one, fitted with two Krieger electric motors, one to each of the front wheels. The battery is said to be of an improved type, but no information is as yet available as to its features, size, and capacity. Leaving London in the morning a run was made to Reading and back, and then to Balham, the distance covered on one charge of the battery being 94¾ miles, or about six miles more than M. Krieger accomplished about a fortnight ago on his run from Paris to Nantes and back.

Röntgen Rays and Electric Light Treatment.—The letter to which we referred in our last issue was followed by a rejoinder in the *Times*, from the pen of Mr. Sydney Holland, chairman of the London Hospital :—

I have seen the letter in the *Times* signed by the surgeon of the London Skin Hospital, with which I imagine the rest of his staff will hardly agree. The gist of the letter is to disparage the cure of lupus as carried out at the London Hospital and started there by her Majesty Queen Alexandra, and to exalt the method of treatment of this fell disease by the Röntgen rays as carried out at his hospital. It may be bold of a layman to reply to a professional man on a professional matter, but as your correspondent has had no experience of the Finsen rays perhaps I may do so with more confidence. First, I may say that the treatment of lupus by the Finsen light is to be discussed at the meeting of the British Medical Association at Cheltenham in August next, and its treatment by the Röntgen rays has already been discussed at a recent meeting of the Röntgen Ray Society. There is nothing new in the treatment of lupus by the Röntgen rays, a large number of suitable cases being thus treated daily at the London Hospital and at other hospitals for both lupus and rodent ulcers. This treatment was inaugurated long before the Finsen light was introduced. We have given up using the Röntgen rays in the majority of cases at the London Hospital, as we have found, from actual experience, that the Finsen treatment is far superior, and is, therefore, worth the greater expense and the infinitely greater trouble. When the disease affects the interior of the nose and mouth then the Röntgen rays must be used, as the Finsen method cannot be applied. If I may enter into technicalities I may say that, so far, there is no evidence that the Röntgen rays are germicide, whereas the rays used in the Finsen treatment are powerfully so. Lupus being a bacterial disease, theory would therefore suggest that it would more likely be successful than the Röntgen rays, and this has been found so in practice. The only disadvantage of the Finsen treatment, in addition to the expense, is the length of the sitting—an hour at a time. Your correspondent ignores the fact that the use of the Röntgen rays is not unattended with risk. As to the expense, it would hardly be becoming in me if I were not to end this letter by asking all who care to aid people so terribly afflicted to help us to do so.

Preparation of Calcium Carbide from Siliceous Materials.—Dr. Rathenau, of Berlin, has taken out an Austrian patent for a process of manufacturing calcium carbide of reasonable purity from materials loaded with silica by making use of the property which certain metals possess of combining with silicon in the electric furnace. Thus, when a mixture of 60 parts of anthracite containing 25 per cent. of silica is smelted electrically with 56 parts of lime and 28 parts of metallic iron, a carbide of good quality is produced, while a ferro-silicon containing 20 to 25 per cent. of the latter element rests on the top of the solidified carbide and can be easily separated from it. This ferro-silicon is also capable of finding employment in the arts.

The Theory of the Wimshurst Machine.—M. Bordier in a note presented to the Academie des Sciences on March 25th, and published in *L'Electricien*, propounds a new theory of the machine with oppositely rotating plates which is usually associated with the name of Wimshurst. The particular variation of this machine he experimented with was that associated with the name of Bonetti, the peculiarity of which is that there are no tinfoil sectors on the rotating plates. The remarkable discovery that M. Bordier has made is that this machine, after it has been excited, will continue to work after the neutralising rods have been removed. The output in the latter case is one-third less than when the neutralising rods are present. M. Bordier attributes this peculiar action to the influence of the charges on the electrodes of the machine, but we imagine the true explanation is to be found in the experiments of Holtz (*Pogg.-Ann.*, Vol. 130, p. 128), where he shows that when a glass surface highly charged with electricity is discharged by points, it takes on a charge of the opposite sign. This is due to the influence of the charge on the glass surface approaching the points. The discharging combs of a Bonetti machine must, according to Holtz's experiments, reverse the electric charge on the plates, and in this way perform the same function as the neutralising rods which can, therefore, be removed without stopping the working of the machine. This action is, however, not so effective as that of the neutralising rods, and we imagine the machine would in the course of time lose its excitement.

Royal Society.—Among papers read yesterday (Thursday) was one by Mrs. H. Ayrton on "The Mechanism of the Electric Arc."

The Pan-American Exposition.—One of the prettiest pieces of decoration in connection with the interior of the Pan-American Exposition buildings is that in the grand dome of the Electricity Building. The colour of the decorations in this magnificent and beautiful structure are cream, light green and heliotrope. Tarltan drapery is the material used, and high up in the dome, right over the Westinghouse exhibit, a canopy top is formed, the beautiful drapery stretching out in graceful form to all sides from a common centre. Midway between the floor and the top of the dome four great signs of the Westinghouse Company are placed, one on each side of the square occupied by their exhibit. In these signs there are a total of nearly 1,000 incandescent lamps, the effect being attractive and beautiful in the extreme. It is worthy of note that the beautiful decoration arranged for the dome of the Electricity Building is to be seen in all its grandeur by night as well as by day, as it is lighted by Nernst lamps. In the dome there are about 100 of them representing, approximately, about 45,000 c.p.

Behr's Mono-Rail System for the South-Eastern Railway.—In an interesting article "From a Correspondent," the *Times* shows how the South-Eastern Railway directors propose facilitating their service by the adoption of the mono-rail between Cannon Street and London Bridge stations. We quote the following extracts as explaining the necessity that exists for improvement, and the details of the scheme so far as it is matured at present :—

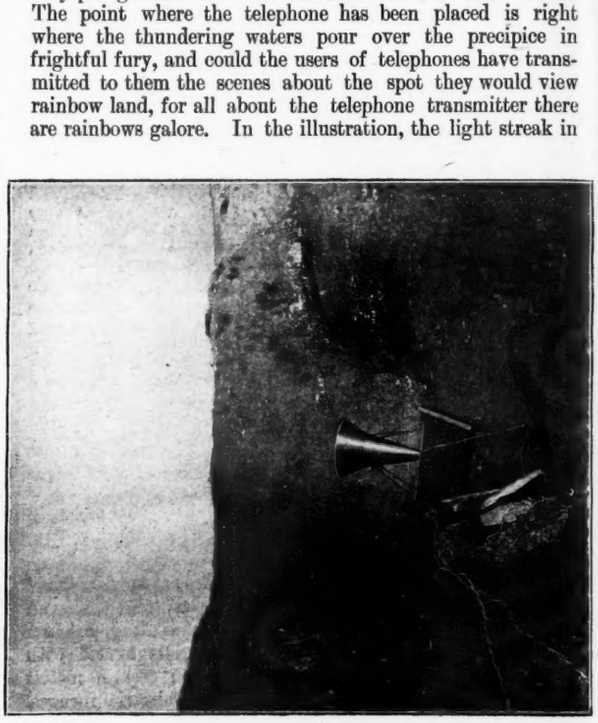
Travellers by the South-Eastern Railway will be glad to learn that the directors are proposing to effect a radical alteration in the method in which Cannon Street Station is worked. At present, although structurally a terminus, it is treated as though it were a wayside station between Charing Cross and the country—that is to say, most of the trains which depart from and arrive at Charing Cross make it a place of call. This arrangement is a fruitful cause of delay, for not only has each train to have a new engine attached to it, but on its way in and out it inevitably fouls lines which would otherwise be free to accommodate other traffic. If the trains were few in number this would not be of much moment, but, on the contrary, they are exceedingly numerous, and the organisation required to work them at all is so delicate that the slightest mishap is enough to throw the whole machine out of gear. Briefly, the remedy which the directors have in mind is the partial abolition of Cannon Street as a wayside station, and the treatment of it as the terminus of a branch line, which it really is. Charing Cross, which is to be greatly enlarged, will then become the true terminus of the line, and the greater number of trains will run direct there from London Bridge without undergoing the cumbrous process of entering and backing out of Cannon Street. Some trains will continue to run direct to Cannon Street, as at present, and of course the local service between it and Charing Cross must be maintained, but it will be served largely by a local service from London Bridge. This will be conducted, not by steam on the existing rails, which, however, will be preserved substantially as they are now, but by electricity on the Behr mono-rail system, the track for which will be carried above the present lines at a height sufficient to clear the tops of the carriages below. All the details of the scheme are not yet settled, and the plans, though they are in hand, are not yet complete, but the general idea is to make the mono-rail track enter Cannon Street at one side of the bridge and, sweeping round in a curve, leave by the other. At London Bridge the construction will be similar; hence the trains will be able to run round and round continuously without any delay for changing engines or shunting, and quite independently of the traffic going on below them on the ordinary rails. In this way it is considered that a two-minute service, or even, if required, a one-minute one, could be easily maintained. The stations, both at Cannon Street and at London Bridge, will of course be high-level ones, above the present platforms, and will not need to be of any very great size with such a frequent service, since there will be no time for any crowd of passengers to accumulate. It is estimated that the whole cost of the scheme will not exceed £100,000—a sum which should in a very short time be recouped to the company by the increased facilities it will gain for conducting its traffic. The use which the South-Eastern Railway is thus intending to make of the Behr mono-rail is an example of what will not improbably be found its true function as regards existing railways. It will be an auxiliary rather than a competitor.

Stands Scotland Where it Did?—A correspondent writes :—"To get much out of a Scotchman has long been admitted to be almost an impossibility, but the worthy Scots of ——— have fairly out-Heroded Herod. A recent tenderer, who submitted three guineas for a specification, to be returned if unsuccessful, unconditionally, received back £3 2s. 8d., 4d. being deducted for the cost of the Post Office order. We pity the successful tenderers with this party of skinflints. N.B.—Will the town clerk be sacked for having omitted to deduct 5d. instead of 4d., the extra 1d. being for the postage stamp?"

The Social Engineer.—One of the most difficult of subjects is that dealt with by Dr. W. H. Tolman in *Cassier's Magazine* under the head of "The Social Engineer," a title that does not quite fit the subject in hand, which is that of housing workpeople and generally treating them as children. We use this last expression not quite seriously, but as one that expresses fairly accurately the view of all such social schemes taken by some people. Our use of the expression, in fact, serves to point out the great difficulties inseparable from such schemes. There are many large works that must build houses for their employés, because, as at Port Sunlight, there are no others to be had. The article contains several illustrations of Port Sunlight cottages. In all such schemes which include the housing problem there is always the danger that the occupation of a company-house in some way gives the company a hold on the occupier; and if we are not mistaken, the case of the Pullman Car Company is one in point. There was at one time great friction. We are inclined strongly to the opinion that by far the best starting-point for all schemes of civilising one's employés is to provide such facilities at the works themselves as will send a man home clean. The arrival of a grimy, dirty man in a clean home is likely to have a discouraging effect on the chief engineer of that home. We would, therefore, first give a man the chance of being clean by doing our duty. We would in due time expect him to be clean, and if he failed then to come up to the standard we would give him the chance again of being dirty—outside our shops. But we would not, as so many have attempted and as the author illustrates with a case, make any attempt to encroach on the hunting ground of the Church by firing off what the author calls a religious talk of seven minutes once a week. Men are apt to resent this, and there is always the danger of doing too much, of thinking a certain line of action will be appreciated, and thus making the men feel obliged to patronise ideas which they perhaps feel it politic to appear to like. After all, no matter how good a home may be built for a man, it rests with him how it shall be kept, and only the naturally tidy people will keep even a model dwelling in order. In every country an occasional firm seems to be able to hit the right idea, but there is nothing in Dr. Tolman's article to point out how it has been done at Port Sunlight, at Angin, at the Cadbury works or elsewhere, excepting a few details of management of a Dutch social scheme. Really well-meant attempts are often met with cold suspicion and indifference. This attitude is unfair, but we know it exists, and it is for this and similar facts that we favour the plan of affording facilities for decent civilisation and getting rid of those who do not care to live up to it, for an employer has a right to refuse to employ unclean workmen just as soon as he awakes to his duty of affording the means to be clean. We know of a case in Glasgow where an employer did afford such facilities, and before a week his filthy workmen had actually picked or broken out the glazed tiles in the walls. Such experiences are painful, and in all the self-adulation of trade unionism we never remember to have seen an instance of men being exhorted to ask for decencies, or to treat fairly the employers who provided them. There are still, we regret to say, workmen who resent being expected to be decent. It is only fit and proper to give such men notice to quit.

Institution of Electrical Engineers.—The annual conversazione of the Institution of Electrical Engineers, held last Friday at the Natural History Museum, was attended by over 1,200 guests, including a large number of ladies, and was, as usual, most enjoyable. The guests were received by the President, Mr. W. E. Langdon, and Miss Langdon and members of the council; among those present were Sir G. Molesworth, Sir H. C. Fischer, Sir Douglas Fox, Sir William Crookes, Sir A. R. Binnie, Sir H. S. Maxim, Sir W. C. Roberts-Austen, Admiral Sir W. Wharton, Profs. H. E. Armstrong, W. E. Everett, Judd, J. Reynolds and other distinguished guests, as well as a large number of members of the Institution. The illuminated address recently presented to the Institution by the American Institute of Electrical Engineers was on view and attracted much attention. Music was supplied by the string band of the Royal Engineers, conducted by Lieutenant J. Zommer.

"The Sound of Many Waters."—The roar of the falling waters of the Falls of Niagara is now transmitted to New York, Buffalo, and other distant places by long-distance telephone in connection with the Bell service. In order to accomplish this a long-distance transmitter has been installed in the Cave of the Winds under the Falls. This transmitter is enclosed in a small box, and has a megaphone attachment to gather the sound of the tumbling waters as they plunge over the cliff and break on the rocks below. The point where the telephone has been placed is right where the thundering waters pour over the precipice in frightful fury, and could the users of telephones have transmitted to them the scenes about the spot they would view rainbow land, for all about the telephone transmitter there are rainbows galore. In the illustration, the light streak in



"The Sound of Many Waters."

front of the megaphone is made by a rainbow of great beauty. In the illustration the transmitter and attachment is seen standing on a ledge of rock in the spray cloud of the Cave of the Winds. Running off from the bottom will be seen the wires that extend to the Niagara Falls Bell exchange, the line being carried across Goat Island on trees and over the bridges to the mainland, where the pole lines of the Bell Company are reached. The switchboard in the Niagara Falls exchange makes it possible for the operator to make connection with outside places for the transmission of the awful roar. In the Bell booth in the Electricity Building at the Pan-American Exposition the noise of the thundering waters will be heard with great distinctness, and will no doubt form an interesting feature of the telephone exhibit.

The Franklin Institute.—We observe from the last issue of the *Journal* of the Franklin Institute, that it is proposed to award the "Elliott Cresson Medal" to Rudolph Diesel, of Munich, Bavaria, for his "Improvements in Internal Combustion Motors." Another announcement is made to the effect that Uriah A. Boyden, Esq., of Boston, Mass., has deposited with the Franklin Institute the sum of $1,000, to be awarded as a premium to "Any resident of North America who shall determine by experiment whether all rays of light, and other physical rays, are or are not transmitted with the same velocity." Memoirs have to be lodged by January 1st, 1902.

The problem has been more specifically defined by the Board of Managers, as follows:—

"Whether or not all rays in the spectrum known at the time the offer was made, namely, March 23rd, 1859 (*sic*), and comprised between the lowest frequency known thermal rays in the infra-red, and the highest frequency known rays in the ultra-violet, which in the opinion of the committee lie between the approximate frequencies of 2×10^{14} double vibrations per second in the infra-red, and 8×10^{14} in the ultra-violet, travel through free space with the same velocity."

Brush Electrical Engineering Company v. The Governor of Malta.—This case came before a specially constituted Court of King's Bench composed of Justices Bruce, Kennedy and Phillimore, for judgment on Wednesday. The case was argued before Justices Kennedy and Phillimore a few weeks ago, but as their lordships differed, an additional judge (Mr. Justice Bruce) was called in and the matter re-argued. The case came before the Court in the form of a special case from which it appeared that differences having arisen between the Brush Electrical Engineering Company, Limited, and the Governor of Malta in respect of claims made against the latter under a contract of March 22nd, 1895, the matter was referred under the arbitration clause in the contract to Mr. E. Manville. It appeared that the claimants undertook to execute certain works for the supply of electricity in Malta, and Sir W. H. Preece, K.C.B., acted as consulting engineer from time to time, when certificates were given by him, and payments made for work done. On November 20th, 1897, the consulting engineer gave the claimants two final certificates, the first certifying the sum due to the claimants, being the final balance, less one-fifth, of the total amount for the contract price deducted therefrom, and the second certifying that the whole of the works had been completed, and had worked satisfactorily for six months from the completion, and the other obligations of the claimants had been performed, and that the above-mentioned one-fifth of the total amount of the contract price was then due to the claimants. In ascertaining the amounts so certified, the consulting engineer deducted from the total price of the work, as determined by him, the sum of £450 as damages for delays under the contract. The respondent, the Governor of Malta, had offered to pay the total amount certified by the engineer, less a sum of £1,000 (in addition to the £450 already deducted), which he claimed to be entitled to set off as liquidated damages for delay. On June 1st, 1900, the parties appeared before the arbitrator, when the claimants professed to give evidence in support of their claim for the total amount of the invoices sent by them to the engineer, less certain deductions which they had allowed. In particular they proposed to give evidence to show that the engineer had not correctly estimated the value of additions and deductions in accordance with paragraph 35 of the contract. The respondent contended that such evidence was not admissible. On his part, the respondent proposed to give evidence to show that he was entitled to deduct the further sum of £1,100 as liquidated damages for delay as provided under the contract. The claimants contended that such evidence was not admissible. The questions of law and the opinion of the Court were: (1) Whether the engineer's certificate was a condition precedent to the claimants' right to recover under the contract; (2) whether the engineer's certificate was binding and conclusive between the parties with regard to the points raised in the statement; (3) whether the engineer's certificate was binding and conclusive between the parties with regard to the amount due to the claimants, apart from the question of damages for delay; (4) whether the engineer's certificate was binding and conclusive between the parties with regard to the amount due to the respondent in respect of damages for delay. Mr. Justice Bruce and Mr. Justice Kennedy, in giving judgment, having stated the facts, said it was unnecessary to answer question one of the special case, because their subsequent answers showed their opinion. Their answer to the second question was "No," the answer to the third, "Yes," and the answer to the fourth, "No." Mr. Justice Phillimore dissented from the majority of the Court on its finding as to the third question. No order was made as to costs.

Obituary.—It is with sincere regret that we record the death of Mr. Alfred Askins, who for some years has occupied the position of Sub-Controller of the Central Telegraph Office. The deceased gentleman died at his residence on Saturday last, 15th inst., from intestinal cancer. His demise is mourned by the whole staff of his office, among whom he was extremely popular because of his good humour, kindly, tolerant disposition, and never-failing charity of word and deed. The funeral took place on Wednesday at New Wimbledon Cemetery.

Dealings with Local Authorities.—It behoves all electrical supply companies to exercise supreme care in their dealings with local authorities, who in certain respects are in a favoured position as regards payment for electricity supplied. The law relating to the recovery of gas rents is substantially the same as that which may be put in operation for the recovery of charges for electricity. Although in the recent case of the South Metropolitan Gas Company *v.* the Mayor, &c., of Bermondsey (reported in the *Times*, May 18th, 1901), the gas company were victorious, the defence set up by the local authority might well have proved successful. The action was brought to recover the sum of £884, the price of gas supplied to the Commissioners of Baths and Washhouses in Rotherhithe, the predecessors of the defendants from 1894 to 1900. Owing to the fact that the dial of the meter in use during that period was misleading, the amount of gas charged for was but one-tenth part of the true amount consumed—an instance of this much-maligned instrument telling tales against its employer, and in favour of the consumers! The mistake had existed since 1881, but the claim for arrears which had accrued prior to 1894 was barred by the statute of limitations. The defendants admitted the mistake, but sought to escape liability on the ground that they could not make or levy a retrospective rate for the purpose of paying the sum claimed, nor could they apply the money in their hands derived from current rates in payment thereof. They also urged, that inasmuch as demand notes had been delivered to the Commissioners stating the quantity of gas consumed and the sum charged in respect thereof, the accounts could not again be reopened! We see no justification for the second defence which the local authority sought to establish. If there was a genuine mistake in the meter register—a mistake, moreover, the extent of which could be gauged by multiplication by 10, it is clear that those who used the gas should be liable. There is, however, some reason for the rule that a local authority shall not lay a retrospective rate. It is inequitable that the cost of an article supplied to, and enjoyed by ratepayers, should be defrayed by those who come after them; but the tendency of the Courts in recent years has been to make the local authority liable in such cases. Thus, in Reg. *v.* Leigh Rural District Council (March 28th, 1898, 14 T.L.R. 325), the defendant Council were under agreement with the Tyldesley District Council to take water from them at a certain rate. A supply of water was provided from 1893 to 1895, when it was discovered that in consequence of some default in the working of the meter, a very much larger quantity of water had been supplied than had been registered. Judgment having gone against the Leigh Council, the Tyldesley Council sought a *mandamus* to enforce payment of the amount found due. The Leigh Council contended that they had no power to make a retrospective rate, and unless the *mandamus* was applied for within the rating year it could not go. Lord Justice A. L. Smith said: "The question in this case is whether, where a just debt is due from a Rural District Council, and the Council have no funds and will not levy a rate to pay the debt justly due, it is necessary that a *mandamus* should be moved for within the rating year, or otherwise the creditor will have to go without his debt? It seems to me that it would be wrong, not to say monstrous, to lay down any such rule. . . . . In such a case excuses may well be given explaining the delay which has occurred before the action is brought." It might be contended in the case under review that the plaintiffs were guilty of *lâches* in not seeing that their meter was registering correctly; but it is satisfactory to know that the decision in the Leigh case is still good law. Nevertheless, the risk of being defeated by a technical point is very much greater when an action is brought against a local authority, than when ordinary mortals are defendants.

Glasgow Technical College.—At a meeting of the Board of Governors this week, the plans of Mr. David Barclay for the new buildings were accepted, so that he is now to be appointed architect. The plans show a floor area of 144,000 sq. ft., and the estimated cost will be £150,000.

Metallic Calcium in Calcium Carbide.—In a recent article on the analysis and purification of acetylene, Rossel and Landriset quote figures which show that the proportion of hydrogen by volume in commercial acetylene usually ranges from 0·2 to 0·3 per cent., and does not exceed the latter limit even when the carbide is made in the presence of an excess of lime. Using an alternating current in the furnace, part of the lime excess volatilises and part melts without decomposition, yielding a carbide of specially fine crystalline appearance; only the small residue is dissociated to metallic calcium, and, according to the present authors, only that part of the residue which happens to be in the middle of the finished lumps of carbide remains as metal and generates hydrogen when it comes in contact with water. Hydrogen in acetylene is objectionable since, burning as it does with a non-luminous flame, it reduces the illuminating power of the crude gas. It is known that a considerable quantity of hydrogen may exist in acetylene when the gas has been generated in a faulty apparatus which encourages overheating, and the quantity may easily reach a figure that seriously affects the readings of the photometer. This hydrogen is due to various decompositions occurring in the process of evolution, and it can be totally avoided by proper construction of the generating plant. The hydrogen arising from the metallic calcium of the carbide is naturally unavoidable; but Rossel and Landriset clearly show that its amount is too small to be in the least degree sensible to the consumer. Indeed, it is difficult to understand how any appreciable amount of metallic calcium can appear in a material made in an alternating furnace, where true electrolysis is theoretically excluded.

Presentation.—Last week Mr. J. A. M. Collier, of the Gateshead Electrical and Supply Company, was presented with an address by his numerous friends at Gateshead on his return from the South restored to health.

NEW COMPANIES REGISTERED.

Hodson & Co., Limited (70,480).—This company was registered on June 13th, with a capital of £2,000 in £1 shares, to adopt an agreement, made June 8th, 1901, between James Hodson, of the one part, and this company of the other part, to acquire and carry on the business of cycle manufacturers and dealers now carried on at Liverpool as Hodson & Co., and to carry on the business of cycle manufacturers, builders of motor cars and carriages of all kinds, mechanical and electrical engineers, machinists, millwrights, founders, wire drawers, tube makers, metallurgists, &c. The first subscribers (each with one share) are:—T. M. Crook, Stanley Grange, Houghton, near Preston, gentleman; J. Hodson, 89, Durning Road, Liverpool, cycle maker; Mrs. A. W. Crook, Stanley Grange, Houghton, near Preston; Mrs. J. E. Barker, Stanley Grange, Houghton, near Preston; J. H. Gabriel, 14, Alfred Place, Liverpool, book-keeper; P. L. Henderson, 54, Upper Parliament Street, Liverpool, cotton salesman; and Mrs. C. J. Hodson, 89, Durning Road, Liverpool. No initial public issue. Table "A" mainly applies. Remuneration as fixed by the company.

Motor Trust, Limited (70,482).—This company was registered on June 13th, with a capital of £3,000 in £1 shares, to adopt an agreement, made June 12th, with G. F. Milnes & Co., Limited, and to carry on the business of manufacturers of, and dealers in, motors and other carriages, boats and launches, cycle builders, carpenters, joiners, electricians, mechanical engineers, machinists, rubber manufacturers, mineral oil merchants, dealers in all apparatus and things required for the generation and supply of electricity, &c. The first subscribers are:—G. F. Milnes, Bella Vista, Banks Road, West Kirby, Cheshire, car manufacturer, with 50 shares; C. Busch, Castle Car Works, Hadley, near Wellington, Salop, with 50 shares; C. Hackett Mitchell, 22, Lord Street, Liverpool, with one share; W. M. Moss Forwood, 15, Union Court, Liverpool, with one share; C. O. Grindrod, 11, Knowsley Road, Rock Ferry, Cheshire, with one share; A. E. Haptie, 5, Durham Road, Seaforth, near Liverpool, manager, with one share; and F. W. Lintern, 22, Beaumont Street, Liverpool, book-keeper, with one share. Minimum subscription 20 per cent. of the shares offered to the public. The number of directors is not to be less than three nor more than nine; the first are to be appointed by the subscribers; qualification, £50; remuneration as fixed by the company.

Inverted Incandescent Lamp Syndicate, Limited (70,461).—This company was registered on June 13th, with a capital of £12,500 in £1 shares, to adopt two agreements with J. Bridger (vendor) and an agreement with the Sunlight and Safety Lamp Company, Limited, and to carry on the business of lamp, burner and fittings manufacturers, makers of appliances for increasing illuminating power, gas manufacturers, electricians, suppliers of gas and electricity, manufacturers of electrical accessories, &c. The first subscribers (each with one share) are:—F. S. Gaylor, 23, Old Broad Street, E.C., solicitor; J. C. Bullen, 72, Huddleston Road, Forest Gate, clerk; J. N. C. Peacock, 56, Moorgate Street, E.C., law stationer; H. D. Brown, 32, Torrington Square, W.C., clerk; G. Humphries, 14, Ducie Street, Brixton, S.W., clerk; M. Benabo, 35, Clemence Street, Burdett Road, E., clerk; and H. J. Loe, 163, Rushmore Road, Clapton, N.E., stationer. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are to be appointed by the subscribers; remuneration, £50 each per annum.

Tadcaster Electricity Company, Limited (70,511).—This company was registered on June 15th, with a capital of £6,000 in £5 shares, to adopt an agreement between John H. Ingleby of the one part, and John Bromet and William Addinell of the other part, to establish stations and works, and to generate, purchase and distribute electrical energy for the purposes of light, heat, motive power and otherwise. The first subscribers (each with one share) are:—John Bromet, Kirkgate House, Tadcaster, architect; William Addinell, Willow Farm, Tadcaster, farmer; Frank Thorman, Kirkgate, Tadcaster, architect; Henry Bromet, Highfield, Tadcaster, solicitor; Henry P. Clinch, Beech Grove, Tadcaster, brewer; George F. Tindall, West Villas, Tadcaster, timber merchant; and John H. Scholefield, Station Road, Tadcaster, gentleman. No initial public issue. The number of directors is not to be less than three nor more than five; the first are John Bromet, William Addinell and Frank Thorman; qualification, 60 shares; remuneration as fixed by the company. Registered office, Station Road, Tadcaster, Yorkshire.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Brompton and Kensington Electricity Supply Company, Limited (25,913).—This company's annual return was filed on May 29th, when 20,000 ordinary and 20,000 preference shares were taken up out of a nominal capital of £300,000 in 40,000 ordinary and 20,000 preference shares of £5 each. £5 per share has been called up on 19,000 ordinary and 15,722 preference, and nothing on 4,278 preference shares, resulting in the receipt of £173,610. 1,000 ordinary shares are considered as fully paid. Mortgages and charges, £21,743.

Brompton and Kensington Electricity Supply Company, Limited (25,913).—Particulars of registered mortgages and charges:—Date of creation of mortgage or charge, March 11th, 1901; amount secured, £15,000; date of resolution creating charge, March 6th, 1901; property charged, uncalled capital in respect of 8,000 preference and 339 ordinary shares of the company, all of £5 each, the preference shares having been issued and allotted at a premium of £3 each, and the ordinary shares at a premium of £2 each; mortgagees or persons entitled to charge, Parr's Bank, Limited, Earl's Court Branch, Kensington, S.W. The above is a temporary loan from the company's bankers, repayable on or before July 1st, 1901.

Bournemouth and Poole Electricity Supply Co., Limited (55,189).—This company's annual return was filed on May 13th, when the entire capital of £150,000 in £10 shares (7,500 preference) had been taken up and paid in full. Mortgages and charges, £70,000.

London Electric Supply Corporation, Limited (24,957).—This company's annual return was filed on May 13th, when 111,000 ordinary and 49,840 preference shares were taken up out of a nominal capital of £850,000 in 200,000 ordinary shares of £3 each, and 50,000 preference shares of £5 each. The full amount has been called up on each share, resulting in a receipt of £582,200, in addition to which £3,740 has been paid on 1,950 forfeited shares. Mortgages and charges, £375,000.

Folkestone Electricity Supply Company, Limited (51,825).—This company's annual return was filed on April 26th, when the entire capital of £50,000 in £5 shares had been taken up and paid for in full. Mortgages and charges, £25,000.

South London Electric Supply Corporation, Limited (50,392).—This company's annual return was filed on April 17th, when the entire capital of £325,000 in £5 shares had been taken up. The full amount has been called up, resulting in the receipt of £324,980; £20 remaining in arrears; no mortgages or charges.

SUPPLY STATION ACCOUNTS.

Bolton Corporation Electricity Accounts.

The exceedingly favourable results attained at Bolton in 1899 not only have been maintained in the last year, but the figures show an all-round improvement. Upon the accounts Mr. A. A. Day, the engineer, is to be congratulated. A considerable increase is shown in capital expenditure, but the most marked change is in output, which has

been nearly trebled resulting in about twice the gross revenue. The traction load is now about two-thirds of the output as is shown by the figures given below:—

Year.	Units generated.	Traction.	Private.	Public.	Total.
1898 ...	560,375 ...	— ...	406,306 ...	10,329 ...	416,635
1899 ...	1,174,478 ...	255,000 ...	559,406 ...	10,386 ...	824,792
1900 ...	2,937,171 ...	1,617,130 ...	803,220 ...	11,387 ...	2,431,737

GENERAL STATEMENT.

	1899.	1900.	Inc.
Total capital expenditure ...	£117,590	**£145,126**	£27,536
Number of units sold	824,792	**2,431,737**	1,606,945
Number of lamps connected ...	56,705	**71,395**	17,690
Gross revenue	£12,087	**£24,099**	£12,012
Gross expenditure...	£6,184	**£13,544**	£7,360
Gross profit	£5,903	**£10,555**	£4,652
Average price per unit sold ...	3·22d.	**2·23d.**	−0·99d.

There are now 77,067 yards of main laid, to which 888 consumers are connected, and 74,395 8-C.P. or equivalent are supplied. The receipts from sale of energy have fallen by 1d. to just under 2¼d. while other reductions have brought the total receipts from all sources down to nearly 2⅓d., or 1⅓d. less than in 1899.

REVENUE STATEMENT.

	1899. Gross	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Sale of energy	£11,081	3·22d.	**£22,547**	2·23d.	−·99d.
Meter rents	296	·09d.	**422**	·04d.	−·05d.
Sale of fittings, &c., and rentals of motors.	710	·21d.	**1,130**	·11d.	−·10d.
Sundry fees	—	—	—	—	—
Gross revenue ...	£12,087	3·52d.	**£24,099**	2·38d.	−1·14d.

The costs sheet shows large reductions under wages and salaries, and smaller economies in the other items. As a result the works costs have been bettered by about ¼d., and the total cost by nearly ½d. per unit. The total cost of 1⅓d. per unit is particularly good. In the report of the committee it is pointed out that there are nine undertakings with total costs of less than 1½d. viz., Leeds, 1·19d.; Edinburgh, 1·22d.; Bradford, 1·22d.; Halifax, 1·23d.; Liverpool, 1·25d.; Bolton, 1·33d.; Nottingham, 1·39d.; and Sheffield, 1·49d.

COST OF PRODUCTION.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Coal..	£2,695	·78d.	£7,751	**·77d.**	−·01d.
Oil, waste, water and engine room stores	400	·12d.	1,045	**·10d.**	−·02d.
Salaries and wages incurred in generation and distribution	1,384	·40d.	2,376	**·23d.**	−·17d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	373	·11d.	679	**·07d.**	−·04d.
Works cost ...	£4,852	1·41d.	£11,851	**1·17d.**	−·24d.
Rent, rates and taxes ..	417	·12d.	628	**·06d.**	−·06d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	610	·18d.	661	**·07d.**	−·11d.
General establishment charges, stationery and printing, law charges and insurance	305	·09d.	404	**·04d.**	−·05d.
Other expenses	—	—	—	—	—
Total costs ...	£6,184	1·80d.	£13,544	**1·84d.**	−·46d.

The borough treasurer, Mr. Swainson, has directed attention to the depreciation written off the capital account. 6 per cent. is now allowed on machinery, mains and transformers, and 10 per cent. on accumulators, meters and instruments. In the 1898 accounts, £1,731 was paid to "Repayment of loan," and £1,205 to reserve fund. In 1899 the heading was "Repayment of loan (depreciation)" £2,012, and reserve fund £1,450, although actually £1,000 of this was paid in aid of the rates, and £450 was carried to reserve fund. Last year the heading is given as "Depreciation and reserve fund," £5,881, and the balance of £858 was paid in aid of the rates. We have below adopted the headings given in the published accounts. Mr. Swainson considers that Mr. Boot's contention is perfectly right, that as the greater includes the less, the "depreciation" of £5,881 covers the £4,076 debt actually cancelled last year.

PROFIT STATEMENT.

	1899.	1900.
Interest on loans and overdraft	£2,440	£3,816
Sinking fund for repayments	2,012	—
Net profit carried to depreciation and reserve funds	451	5,881
" " to credit of rates	1,000	858
Gross profit	£5,903	£10,555

Bedford Corporation Electricity Accounts.

The anticipations formed on the analysis of the 1899 accounts of the Bedford Corporation have unfortunately not been realised by the results of last year. The net loss for the past four years is as follows:—

Year ...	1897	1898	1839	1900
Net loss ...	£1,200	£981	£288	£912

The output has increased over 25 per cent., and the load rather less than this ratio, so that the business is steadily making progress. The total output is nearly two-thirds of a million units.

GENERAL STATEMENT.

	1899.	1900.	Inc.
Total capital expenditure ...	£67,621	**£77,769**	£10,148
Number of units sold	549,146	**655,574**	115,428
No. of lamps connected	25,368	**32,234**	6,866
Maximum load in KW.	449	**550**	101
Gross revenue	£8,798	**£10,780**	£1,982
Gross expenditure...	£4,881	**£7,243**	£2,362
Gross profit	£3,917	**£3,537**	£380
Average price per unit sold ...	3·82d.	**3·83d.**	+·01d.

The increase in gross revenue is about £1,000 less than for 1898—99, but the total is nearly double the figure for 1898. There is practically no change in the receipts per unit sold. The output was distributed thus:—

Year.	Units at 6d.	Units at 4½d.	By contract.	Public lighting.	Pumping sewage.
1898	£1,641	£1,920	£25	£2,131	—
1899	—	£4,838	£18	£2,524	£1,111
1900	—	£6,342	£15	£2,744	£1,335

The capacity of plant installed is 640 KW., and the number of public lamps 530, varying from 16 C.P. to 200 C.P. according to position. The prices charged are, private 5d. less 10 per cent. for cash in a month, and power or public lightin g 3d. per unit.

REVENUE STATEMENT.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Increase.
Sale of energy	£8,591	3·32d.	**£10,474**	3·83d.	+·01d.
Meter rents	193	·09d.	**252**	·09d.	·00d.
Sale of lamps, &c.	—	—	**11**	·00d.	·00d
Sundry receipts, discounts, &c.	14	·00d.	**43**	·02d.	+·02d.
Gross revenue ...	£8,798	3·91d.	**£10,780**	3·94d.	+·03d.

The costs have gone back to nearly what they were in 1898. Coal is the most serious change, showing over ⅓d. increase; wages remain the same as in 1899; while rent, rates and establishment charges show trivial reductions, the other items have slightly risen.

COST OF PRODUCTION.

	1899. Gross.	1899. Per unit.	1900. Gross.	1900. Per unit.	Inc.
Coal, and unloading same..	£2,535	1·13d.	£4,061	**1·49d.**	+·36d.
Oil, waste, water and engine room stores.	372	·16d.	471	**·17d.**	+·01d.
Salaries and wages incurred in generation and distribution, and attendance on public lamps.	825	·37d.	1,004	**·37d.**	·00d.
Repairs and maintenance of buildings, engines, boilers, dynamos, and renewals, &c., of street lamps.	419	·19d.	699	**·26d.**	+·07d.
Works costs ...	£4,151	1·85d.	£6,235	**2·29d.**	+·44d.
Rent, rates and taxes ..	183	·08d.	204	**·07d.**	−·01d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	360	·16d.	603	**·22d.**	+·06d.
General establishment charges, stationery and printing, law charges and insurance	187	·08d.	201	**·07d.**	−·01d.
Other expenses	—	—	—	—	—
Total costs ...	£4,881	2·17d.	£7,243	**2·65d.**	+·48d.

The financial result is due to a combination of adverse circumstances. The financial charges have increased by £244. Owing to the increased costs the gross profit has fallen by £380. Taking these changes together, the difference is £624, which, added to the loss of £288 in 1899, brings the total loss in last year's accounts up to £912. There is every reason why the Corporation should charge ½d. more per unit to cover the increased cost of fuel, &c., and thereby enable the revenue to meet the necessary expenditure.

PROFIT STATEMENT.

	1899.	1900.
Interest on loans	£1,836	£1,887
Sinking fund for repayments	2,369	2,562
Net profit carried forward	−288	−912
Gross profit	£3,917	£3,537

CITY NOTES.

Greenwood & Batley, Limited.

The directors' report for the year ended March 31st last, to be presented at the meeting to be held in London on 29th inst., states that after providing for interest on the debentures and expenses of management, writing off £7,500 for depreciation on buildings and plant, and making due provision for doubtful accounts, the accounts show a profit of £35,626, and there is also £463 brought forward, making £36,090. The directors have allotted £5,000 towards the cost of completing the electric power installation throughout Albion Works, and £1,000 as a provision against contingencies. They have further appropriated £10,000 to the reserve fund, increasing it to £20,000, and they recommend dividends at the rates of 7 per cent. per annum on the preference shares, and of 5 per cent. per annum on the ordinary shares, absorbing £15,615, and leaving £4,474 to be carried forward. The directors having secured a long lease of premises at Abbey Wood, near Woolwich Arsenal, with full Government loading license under the Explosives Act, have arranged to terminate the tenancy of the Greenwich Loading Works, and transfer the plant to the far more convenient and suitable works above-named.

Isle of Man Electric Tramways Company.—The *Liverpool Courier* says that Messrs. Forshaw & Hawkins, solicitors, Liverpool, have issued an important circular to the shareholders in the Isle of Man Tramways and Electric Power Company, Limited. The circular impresses the importance of purchase by the shareholders of the company's concern from the liquidator. They suggest that the shareholders should subscribe capital which, added to the £175,000 debentures, which could probably be raised, would be sufficient to purchase the undertaking. To pay the preliminary expenses the shareholders are asked to subscribe 5s. per £100 of the holding. There is no probability of the shareholders receiving anything from the realisation of the company's assets.

Stock Exchange Notice.—The Committee has ordered the undermentioned to be quoted in the Official List:—Castner-Kellner Alkali Company, Limited, further issue of £100,000 4½ per cent. first mortgage debenture stock.

British Electric Traction Company.—The directors recommend a dividend at the rate of 12 per cent. per annum for the half-year ended March 31st last, making, with the interim dividend, a total distribution of 9 per cent. for the year.

W. T. Glover & Co., Limited.—The debenture transfer books will be closed from June 18th to 30th for the preparation of interest warrants.

City of London Electric Lighting Company.—The debenture transfer books will be closed from June 17th to 29th.

Eastern Extension Telegraph Company.—Interim dividend for quarter ended March 31st., 2s. 6d. per share.

TRAFFIC RECEIPTS.

Blackburn Corporation Tramways.—The receipts for the week ending June 14th were £553; corresponding week last year, £461; increase, £92. Total to date, £11,096; corresponding period last year, £10,061; increase, £1,035. Miles of track open, 8¾.

Blackpool and Fleetwood Tramways.—The receipts for the week ending June 15th were £553; corresponding week last year, £990; decrease, £437. Total to date, £8,425; corresponding period last year, £8,718; decrease, £293.

Bristol Tramways and Carriage Company.—The receipts for the week ending June 14th were £4,504; corresponding period last year, £3,180; increase, £1,324.

Central London Railway.—The receipts for the week ending June 15th were £6,239; previous week, £6,063; increase, £176. Total receipts to date (24 weeks), £148,770. Miles open, 6.

City and South London Railway.—The receipts for the week ending June 16th were £1,862; corresponding week last year, £1,480; increase £382. Total to date, £47,071; corresponding period last year, £30,735; increase, £16,336. Miles open, 1901, 4½; 1900, 4½.

Dover Corporation Tramways.—The receipts for the week ending June 15th were £217 15s. 0d.; corresponding week last year, £214 8s. 7d.; increase, £3 6s. 5d. Total to date, £4,348 10s. 0½d.; corresponding period last year, £4,072 6s. 8½d.; increase, £316 3s. 4d. Miles of track open, 8; Car miles run, 1901, 5,080; 1900, 4,991. Number of cars, 11.

Dublin United Tramways Company.—The receipts for the week ending June 14th were as follows:—D. U. T. Co., electric cars, £3,778 15s. 5d.; D. S. D. Co., electric cars, £913 10s. 3d.; total £4,692 5s. 8d.; corresponding week last year—D. U. T. Co., electric cars, £3,665 5s. 11d.; ditto, horse cars, £61 16s. 6d.; D. S. D. Co., electric cars, £1,005 4s. 10d.; total, £4,732 7s. 3d.; decrease, £40 1s. 7d.; aggregate to date, £97,914 9s. 7d.; aggregate to date last year, £98,694 18s. 3d.; decrease, £780 9s. 8d. The mileage worked is 45 miles electrically, as against 42 miles electrically, and 2 miles by horses, for the corresponding period last year.

Glasgow Corporation Trams.—The receipts for week ending June 15th were £11,419 15s. 10d., compared with £9,986 18s. 2d. for the corresponding period last year.

Liverpool Corporation Tramways.—The returns for the fortnight ended June 8th show a revenue of £19,748 19s. 5d., against £17,341 4s. 8d. in the corresponding fortnight last year. The mileage run was 428,012, against 345,557, and the number of passengers carried 4,221,716, against 3,327,850 in the corresponding fortnight of 1900. 329 electric cars and seven horse cars are now employed on the system, against 140 electric cars and 159 horse cars at the same date last year.

Liverpool Overhead Railway.—The receipts for the week ending June 16th were £1,607; corresponding week last year, £1,424; increase, £183. Total to date, £37,713; corresponding period last year, £34,214; increase, £3,499. Miles open, 6 miles 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The Stock Exchange remains cautiously bullish. That is to say, it admits the scope now existing for an all-round advance in investment markets, but is also on the look-out for untoward incidents which may modify the improved situation. For improved the outlook certainly is. Besides the reasons we adduced last week in favour of better prices for industrial descriptions, there is the lowered Bank Rate to help quotations upwards. To a small extent these latter have responded to the quickening breath of the Bank, and Consols are now a full point higher than they were in the depression of a fortnight ago. But electrical investments, in common with many other stocks and shares in which the market is not very active, are still quiescent, the tone remaining very hard. We are somewhat inclined to question whether the higher class shares are not better than speculative mining descriptions as media for making money. There is, at all events, considerably more margin for an intrinsic rise, say in some of the Supply shares, than there can be in a good many South Africans.

Business in the Electricity Supply department is steady. So report the jobbers who deal therein, and they declare further that the trade consists mainly of small parcels of shares, an indication that the public are beginning to look with favourable eyes upon the finance of the lighting industry. Coal is now much cheaper than it was a year ago, and although the price of copper is maintained, the more settled condition of the material and the labour markets should conduce to the better dividends which are already being prophesied from these companies. Without adopting the optimistic tone, there does not seem to be good reason for anticipating an appreciation of prices in this department.

The British Electric Traction dividend, making 9 per cent. for the twelvemonth, was met by a rise in the price of the shares. It will be remembered that the distribution for the preceding 15 months was at the rate of 8 per cent. per annum. The final call of £4 per share on the new Preferences became due last Saturday, and the special settlement will thus be made in fully-paid shares, contrary to the preliminary suggestion. On these new Preferences a small premium of 7s. 6d. per share is now well established, and, moreover, a line of the company's Debenture stock that has been offering in the market for some weeks past is now placed in good hands.

Telegraph varieties have got into what appears to be a changeless groove of inanition. With the exception of Amazon Debenture, there has been no important fluctuation in telegraph stocks for the last three months. The little flutter in the Anglo-American market, due to the rebuilding of the Yankee railroad boom, has come to a conclusion for the time being, and there is no temptation to buy the Deferred. We adhere to our opinion that the "B," the Preferred stock, is a good second-class investment, paying 6 per cent., a rate which no sane person expects to get without running a certain amount of risk.

In the manufacturing section, Babcock & Wilcox shares strengthened upon the announcement that their contract for the *Hermes* boilers will be as much as £30,000. The new boilers are to take the place of the Belleville, and the company may be trusted to make the most of the footing which this order will place them upon in Government circles. It is worth noting that Babcock shares now pay about 5 per cent. on the money—a return which does not seem likely to fall off except by the probable appreciation of the price of the shares. Willans & Robinson pay 6½ per cent. on the money.

Misfortune on misfortune dogs the track of hapless Welsbach stockholders. The latest takes the form of resignation by the two directors who were elected to the board some 18 months ago, and from whose efforts such great things were expected. One of them, Mr. H. L. Peters, is the managing director of the undertaking, and the other, Mr. Charles L. Samson, joined the board at the date of Mr. Peters' election. Naturally, the news has not assisted the flatness of Welsbach securities, and the market is more nervous than ever, which is quite the reverse to the dominant sentiment as regards Central London shares. The reduction in the price of coal in the coming half-year is considered as a strong factor in the case of those who look for a steady rise in "Twopenny Tube" Ordinary and half-shares.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for he last three years. 1898.	1899.	1900.	Closing Quotation June 12th.	Closing Quotations June 19th.	Business done during week ended June 19th, 1901. Highest.	Lowest.
96,900	African Direct Telegraph, 4 % Debs	100	...	...	...	100 —103	100 —103	102¼	...
119,700£	Amazon Telegraph 5 % Debs., Nos. 1 to 1,2?0 Red. ...	100	...	...	...	78 — 83	78 — 83	...	...
822,700£	Anglo-American Telegraph	Stock	£3 9s.	73/6	3⅛%	54 — 57	53 — 56	53	...
3,088,540£	Do. do. 6 % Pref	Stock	6 %	6 %	6 %	97 — 39	98 —100	99¼	98
3,088,540£	Do. do. Deferred	Stock	18s. %	£1 7s.	5s.%	10 — 10½	10½— 10⅝	10 7/16	10½
44,000	Chili Telephone, Nos. 1 to 44,000	5	3 %	4 %	...	3½— 4	3½— 4	...	...
13,333,300$	Commercial Cable	$100	8 %	8 %	...	175 —185	175 —185	...	...
1,589,496£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	101 —103	101 —103	102½	101
16,000	Cuba Telegraph	10	8 %	7 %	...	7 — 8	7 — 8	...	...
6,000	Do. 10 % Pref.	10	10 %	...	...	14½— 15½	14½— 15½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	3 — 4	3 — 4	...	...
6,000	Do. do. 10 % Cum. Pref.	5	...	...	...	9 — 10	9 — 10	...	...
30,000£	Do. do. 4½ % Debs.	50	...	...	...	100 —104%	100 — 104%	...	...
60,710£	Direct United States Cable	20	3½%	3 %	3 %	10¼— 10⅜	10¼— 10⅜	10 7/16	...
108,300£	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	140 —145	140 —145	143⅜	142½
1,826,888	Do. 3½ % Pref. Stock	100	...	...	...	90 — 93	90 — 93	90½	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	...	...	...	110 —114	109 —113	112½	109
300,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13½— 14	13½— 14	13⅝	13⅝
320,000£	Do. 4 % Deb. Stock	Stock	...	...	...	111 —116	111 —116	...	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb. Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 —103%	100 —103	...	...
180,227	Globe Telegraph and Trust	10	5⅛%	5¼%	...	9¾— 10¼	9¾— 10¼	10	...
180,042	Do. do. 6 % Pref.	10	6 %	...	...	14¼— 15¼	14¼— 15¼	14⅞	14 13/16
150,000	Great Northern Telegraph, of Copenhagen	10	12½%	...	15 %	31 — 33	31 — 33	...	...
82,000£	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	43 — 47	43 — 47	43½	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	...	...	...	103 —106	103 —106	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	2½%	...	¼— ⅛	¼— ⅛	...	...
86,492	Do. do. do. 5 % Pref., Nos. 1 to 86,492	1	4 %	5 %	...	⅝— 1	⅝— 1	...	..
590,000	National Telephone, 1 to 590,000	5	6 %	5 %	5 %	3½— 3⅝	3½— 3⅝	3 7/16	3½
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11⅛— 12⅜	11 — 12	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11½— 12½	11 — 12	11½	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4¼— 4½	4¼— 4½	4½	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	87 — 90	89 — 92	90½	89
500,000£	Do. 4 % Deb. Stock Red....	100	...	...	4 %	95 — 98	95 — 98	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	6 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	...	...	...	100 —103	100 —103	...	...
11,839	Reuter's...	8	5 %	5 %	5 %	7 — 8	7 — 8 xd	7⅜	...
3,381	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	125½	...
58,000	United River Plate Telephone	5	6 %	7 %	...	5 — 5½	5 — 5½	5 5/16	5¼
40,000	Do. do. 5 % Cum. pref. Nos. 1—40,000	5	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
179,947£	Do. do. 5 % Debs.	Stock	...	...	...	103 —106	103 —106	...	...
171,000	West African Telegraph, 5 % Debs....	100	...	...	...	98 —101	98 —101	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ⅜	¼— ⅜	...	...
150,000£	Do. do. 4 % Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	13⅜—14½	13⅜— 14½	14	13 13/16
75,000£	Do do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	102 —105	102 —105	...	...
348,777£	Do. do. 4 % Deb. Stock Red.	100	...	...	...	102 —105	102 —105	...	...
88,321	West India and Panama Telegraph	10	2 %	5%	...	⅜— ⅝	⅜— ⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	...	...	...	5 — 6	5 — 6	5½	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	...	...	...	3 — 5	3 — 5	3¾	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	...	...	...	103 —106	103 —106	102	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	6 %	6 %	6 %	7⅞— 8¼	7⅞— 8¼	8	...
12,000	Do. do. 7 % Cum. Pref....	5	...	...	...	8½— 9	8½— 9	...	...
50,000	Charing Cross and Strand Electricity Supply	5	8 %	9 %	9 %	9 — 10	9 — 10	9⅝	...
20,000	Do. do. do. do. 4½% Cum. Pref.	5	...	...	...	5¼— 5⅝	5¼— 5⅝	5⅞	5 15/16
34,000	*Chelsea Electricity Supply, Ord.	5	6 %	6 %	5½%	5⅜— 6¼	6 — 6½	6⅛	5⅞
150,000£	Do. do. do. % Deb. Stock Red. ...	Stock	...	...	...	109 —112	109 —112	110¼	...
70,579	City of London Electric Lighting, Ord. 40,001—110,579...	10	6 %	4 %	0 %	8½— 9½	8½— 9½	8⅝	8 15/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	...	...
400,000£	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	122 —127	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	4 %	4 %	8½— 9½	8½— 9½	9 1/16	9
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	11½— 12½	11½— 12½	12⅜	...
200,000£	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	105 —108	105 —108	...	...
35,300	Edmundson's Elec. Corp., Ord. Shares	5	6 %	6 %	...	5¼— 5⅜	5¼— 5⅜	5 1/16	...
20,000	Do. do. 6 % Cum. Pref.	...	...	...	...	5¼— 5⅜	5¼— 5⅜	...	...
120,000£	Do. do. 4½ % 1st Mort. Deb. Stock. ...	100	...	...	...	104 —107	104 —107	106¼	105⅝
21,000	Kensington and Knightsbridge Electric, Ord.	5	...	...	...	11½— 12½	11½— 12½	...	...
90,000	Do. do. do. 4 % Deb. Stock	Stock	...	...	...	102 —105	102 — 105	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1¼— 1⅜	1¼— 1⅜	...	...
49,840	Do. do. do. do. 6 % Pref.	5	6 %	...	...	4 — 5	4 — 5	...	...
250,000£	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	98 —101	96 —100 xd	...	..
85,000	Metropolitan Electric Supply, 101 to 62,500	10	5 %	5 %	6 %	13⅜— 14½	13⅜— 14½	14 3/16	13¾
220,000£	Do. 4½% First Mortgage Debenture Stock	...	...	...	...	110 —113	110 —113	...	...
250,000£	Do. 3½% Mort. Deb. Stock Red.	Stock	...	...	...	96 — 99	96 — 99	...	...
6,452	Notting Hill Electric Lighting	10	6 %	7 %	7 %	15½— 16½	15½— 16½	15⅞	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	15⅜	15¼
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½— 9½	8½— 9½	...	...
150,000£	Do. do. 3½ % Deb. Stock Red. ...	100	...	...	...	98 —101	98 —101	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2½	2	...
50,000£	Do. do. 4 % Deb.	100	...	...	...	80 — 90	80 — 90	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	2½— 3½	2½— 3½	3	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000... ...	5	12 %	13 %	10½%	12 — 13	12 — 13	12½	12⅜

* Subject to Founders Shares. Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1898.	1899.	1900.	Closing Quotation June 12th.	Closing Quotation June 19th.	Business done week ended June 19th, 1901. Highest	Lowest
		‡							
20,000	British Aluminium 7 % Cum. Pref.	10	...	...	...	7½ — 8½	7½ — 8½	...	...
300,000*l*	Do. do. 5 % 1st Mort. Deb. Stock Red. ...	Stock	...	...	...	89 — 93	85 — 93	...	...
45,000	British Electric Traction	10	6 %	8 %	9 %	14½ — 15½	15 — 16	15½	...
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12 — 13	12 — 13	12⅜	12⅜
350,000*l*	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	120 —123	121 —124	124	121½
70,000	British Insulated Wire Ord.	5	15 %	20 %	15 %	9½ — 10½	9½ — 10½	...	...
70,000	Do. do. 6 % Cum. Pref.	5	...	...	...	5⅝ — 6¼	5⅝ — 6¼	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	2	5 %	6 %	...	1⅝ — 1⅞	1⅝ — 1⅞	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000 ...	2	6 %	6 %	...	2⅛ — 2⅜	2⅛ — 2⅜	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock	Stock	...	...	...	103 —108	103 —108	...	...
108,710*l*	Do. do. 4½ % Perp. 2nd Deb. Stock ...	Stock	...	...	...	101 —104	101 —104	...	...
30,000	Callender's Cable Construction shares, Nos. 1—30,000 ...	5	15 %	15 %	15 %	14 —15	14 — 15	14¼	...
40,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	5⅝	...
90,000*l*	Do. do. 4½ % 1st Mort. Deb. Stock Red ...	Stock	...	...	...	109 —113	109 —113	...	...
206,297	Central London Railway, Ord. Shares	10	...	...	...	9½ — 9⅝	9½ — 9⅝	9⅝	...
78,703	Do. do. Pref. half-shares	5	...	...	...	4½ — 5	4½ — 5	5	4 1/16
78,703	Do. do. Def. do.	5	...	...	...	4⅜ — 5¼	4⅜ — 5¼	...	...
855,000	City and South London Railway	Stock	2⅛ %	1⅞ %	1½ %	51 — 53	55 — 57	56	55
37,500	Do. do. Ord. shares Nos. 22,501 to 60,000	10	...	...	...	4⅜ — 5¼	5½ — 5⅝	5½	5 5/16
54,000	Crompton & Co., Nos. 1 to 54,000	3	6 %	7½ %	...	3½ — 4	3½ — 4	3¾	...
100,000*l*	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red	...	...	...	...	101 —104	102 —105	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	1 — 1½	1 — 1½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139 ...	5	6 %	6 %	...	2 — 3	2 — 3	...	...
344,023*l*	Do. do. do. 4 % Deb. Stock Red ...	100	...	...	...	87 — 89	87 — 89	87½	...
100,000*l*	Do. do. 5% 2nd Deb. Stock Prov. Certs. all pd.	100	...	...	...	94 — 98	94 — 98	...	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	1⅞ — 2¼	1⅞ — 2¼	1 13/16	1⅞
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000... ...	2	7 %	...	...	2½ — 3	2½ — 3	2¼	...
182,500*l*	Do. do. 4 % Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	100 —103	101 —104	...	...
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	14 %	15 %	20 %	15½ — 16½	15½ — 16½	16	15⅞
35,000	Do. do. do. 4½ % Pref.	5	...	4½ %	4½ %	5½ — 6	5½ — 6	...	...
50,000*l*	Do. do. do. 4½ Mort. Deb. Stock...	Stock	...	...	...	107 —111	107 —111	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21⅛	21
300,000*l*	Do. do. do. 4 % 1st Mort. Deb	100	...	...	...	101 —104	101 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½ %	3⅝ %	3¼ %	8½ — 8¾	8 — 8½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5	...	13 — 13½	12½ — 13½	...	...
	§Rosling, Appleby & Fynn 6 % Cum. Pref.	£1	...	...	6 %	19/- to 20/-	... — ...	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	17½ %	35 — 39	36 — 40	...	...
150,000*l*	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	102 —105	102 —105	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	8 %	12 %	12 %	10½ — 11½	10 — 11	...	...
20,000	Do. do. 5 % Cm. Prf. Nos. 1 to 20,000...	5	...	...	...	5½ — 6	5½ — 6	5⅞	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	3 %	3 %	3 %	93 — 96	93 — 96	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § From Bradford Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Consolidated Telephone Construction and Maintenance, 1/16—3/16.
National Electric Free Wiring, 12/6 paid, 1/16—1/8.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 15½—16½.
Do. do. Pref. (£10 pd.), 10—11.
*T. Parker, £10 (fully paid), 16½.

* From Birmingham Share List.

Bank rate of discount 3½ per cent. (June 6th, 1901).

MARKET QUOTATIONS, Wednesday, June 19th.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	32/-	32/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	£33 10	..
a ,, ,, ..	per ton	£30	£30	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£15	£15	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90%)..	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£23	£23	..
a Lead, Nitrate	per ton	£24	£24	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/6	2/6	..
a Naphtha, Solvent (90% at 160° C).	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8¼d.	8¼d.	..
a ,, Caustic (75/80%) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£85	£85	..
a Shellac	per cwt.	61/-	61/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
,, Bichromate, casks ..	per lb.	2¾d.	2¾d.	..
METALS, &c.				
b Aluminium Wire, in ton lots..	per ton	£224	£224	..
b ,, Sheet, in ton lots	per ton	£191	£191	..
p Babbitt's metal ingots.. ..	per ton	£75 to £140	£75 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	7½d.	7½d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	8½d.	8½d.	..
c ,, Wire, basis	per lb.	8d.	8d.	..
c Copper Tubes (brazed) ..	per lb.	11d.	11d.	..
c ,, ,, (solid drawn) ..	per lb.	10¾d.	10¾d.	..
g Copper Bars (best selected) ..	per ton	£85	£85	..

METALS, &c. *(continued.)*		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£85	£85	..
g ,, Rod	per ton	£86	£86	..
c ,, (Electrolytic) Bars ..	per ton	£82	£82	..
c ,, ,, Sheets ..	per ton	£90	£90	..
c ,, ,, Rod ..	per ton	£84	£84	..
c ,, ,, H.C. Wire	per lb.	9¾d.	9¾d.	..
f Ebonite Rod	per lb.	3/-	3/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1,5	1/5	..
h Gutta-percha fine	per lb.	8/-	8/-	..
h India-rubber, Para fine	per lb.	3/8½	3/9 to 3/10	dec.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants) ..	per ton	44/10½	45/2	3½d. dec.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire, galvanised No. 8 ..	per ton	£10 5	£10 5	..
g Lead, English Ingot	per ton	£12 12 6 to £12 15	£12 12 6 to £12 15 6	..
g ,, ,, Sheet	per ton	£13 10	£13 10	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bott.	£9 2 6	£9 2 6	..
d Mica (in original cases), small ..	per lb.	3d. to 9d.	3d. to 9d.	..
d ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, large ..	per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings	per lb.	1/0½ to 1/3	1/0½ to 1/3	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, ,, strip & sheet	per lb.	From 1/3	From 1/3	..
o Platinum	per oz.	£4 1	£4 1	..
p Silicium Bronze Wire	per lb.	10½d. to 1/0½	10½d. to 1,0½	..
i Steel, Magnet, acc'd'ng to desc'p'n	per ton	From £15 to £40	to £40	..
i ,, ,, in bars		£58	£58	..
g Tin, block	per ton	£131 10 to £132 10	£133 10 to £134	£2 dec.
g ,, foil	per lb.	1,6	1/6	..
n ,, wire, Nos. 1 to 16	per lb.	1/9	1,9	..
p White Anti-friction Metals — "White Ant" brand	per ton	£35 to £65	£35 to £65	..
j Yarns, Cotton, Single 10 lb. b'ndl's	per lb.	8¾d.	8¼d.	..
j ,, Best Flax, 6 lea.	per lb.	6d.	6d.	..
j ,, Hemp, 3 ply 10 lbs. ..	per lb.	4½d.	4½d.	..
j ,, ,, Russian, 10 lbs. ..	per lb.	5½d.	5½d.	..
j ,, Jute, 180 lbs. rove ..	per ton	£14 5	£14 5	..
k Zinc, Sh's. (Vielle Montagne ond.)	per ton	£22 10	£22 10	..

Quotations supplied by { a Messrs. G. Boor & Co. b The British Aluminium Co., Ltd. c Messrs. Thos. Bolton & Sons. d Messrs. F. Wiggins & Sons. e Messrs. Frederick Smith & Co.

Quotations supplied by { f India-Rubber, G.-P. and Teleg. Works g Messrs. James & Shakespeare. [Co., Ltd. h Messrs. Jackson & Till. i Messrs. Bolling & Lowe. j Messrs. Henry C. Yeo & Co.

Quotations supplied by { k Messrs. Morris Ashby, Limited m Messrs. W. T. Glover & Co., Ltd. n Messrs. P. Ormiston & Sons. o Messrs. Johnson, Matthey & Co., Ltd. p The Phosphor Bronze Company, Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS.

STORAGE BATTERIES IN ELECTRIC POWER STATIONS, CONTROLLED BY REVERSIBLE BOOSTERS.

By J. S. Highfield, Member.

(*Paper read May 9th*, 1901.)

(*Continued from page* 1038.)

Batteries in Traction Stations.

In power stations supplying energy to work tramways and railways, the character of the load is entirely different from that of a lighting load. The output varies but little according to the time of the year, or from day to day. There are peaks during which the output and the maximum load are greater than at other times, but not nearly to so great an extent as in lighting work. The load, however, varies very rapidly and through very wide limits, the variations becoming less as the number of cars or trains increases. In the case of a road operating 50 to 100 cars, the maximum loads are usually about three times the mean load. With 100 to 200 cars, the maximum loads are usually less than twice the mean load. Fig. 5 shows the load variations for a road operating 25 to 30 cars; fig. 6 shows the variations of the mean load at any time during the day,

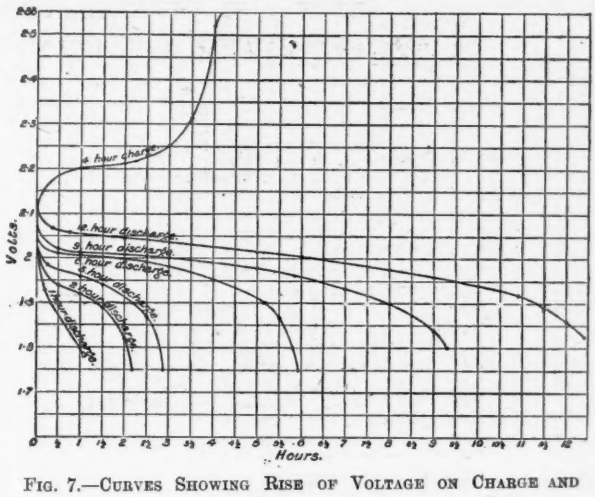


Fig. 7.—Curves Showing Rise of Voltage on Charge and Fall of Voltage on Discharge at Different Rates.

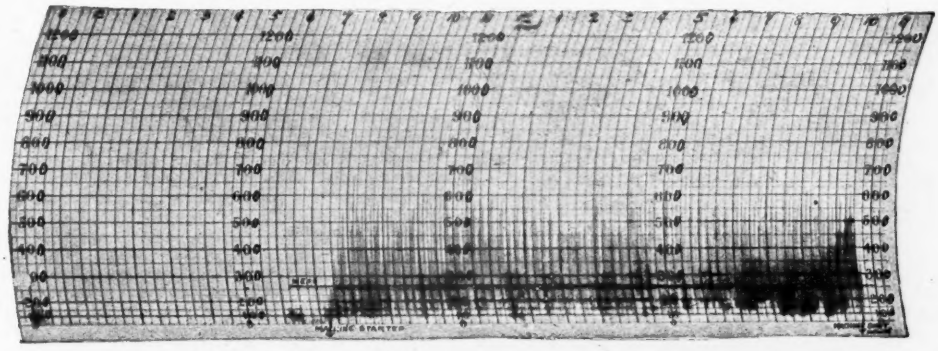


Fig. 5.—Recorder Curves for Traction Load Worked with Battery and Reversible Booster.

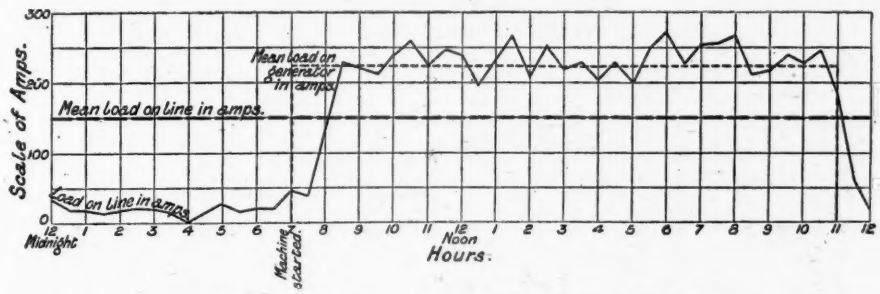


Fig. 6.—Traction Load Diagram. Generator and Battery.

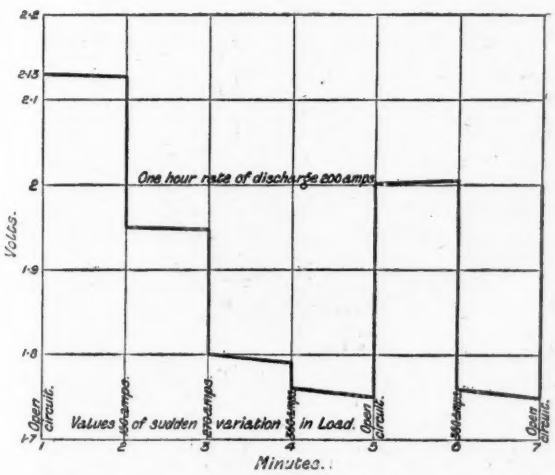


Fig. 8.—Variation in Volts of One Cell with Sudden Variation in the Load.

this curve being plotted by taking the output in units every half-hour, and from the readings working out the load. In each figure the horizontal line shows the average load, during the hours of running the plant necessary to turn out the metered units. It is evident from the curves that a generator of 200 kw. can easily give the output if a battery be used to discharge on the peaks. For such a load the battery may be used at the one-hour rate of discharge normally, and on occasions at even a greater rate. Such occasions might be when the road is very heavy through a snowfall or like reason, or when cars get bunched during holiday traffic. In the case of a traction load, therefore, the capital cost of the battery may be taken at the one-hour rate—that is, about £15 to £18 per kw. This is considerably less than the cost of the running plant.

For the load shown in fig. 5 over 24 hours, the load factor is 23 per cent. Such a load cannot be very economical, since the steam plant would be, on the average, very lightly loaded.

The plant load factors for a lighting station and a traction station differ in one respect—in a lighting station, by using units of several sizes, the engines may be run nearly at their full load always, but the load on the boiler plant will vary considerably; in a traction station, on the other hand, the boilers will supply, during 16 hours, about the same amount of steam per hour. The engines must, however, be large enough to take the maximum load, and therefore work at only a small part of their full capacity.

If a battery be used in parallel with the steam plant on the load shown in fig. 5, it will take up some portion of the peaks; but the conditions of battery discharge and charge must be such, that the

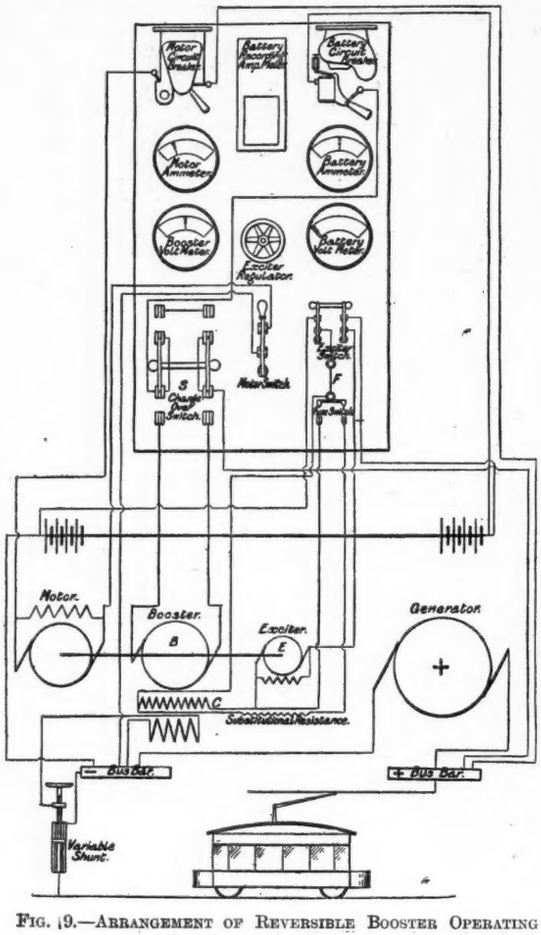


Fig. 9.—Arrangement of Reversible Booster Operating Traction Load.

of hours, say, 16 daily, to turn out the required number of units, and to allow the battery to take charge of all peaks, and to charge when the load is small, and to work the entire service for the remainder of the day.

It is here necessary to consider the nature of the battery as a reservoir of energy. Fig. 7 shows the well-known rise of voltage on charge and fall of voltage on discharge at various rates. Fig. 8 shows the fall in voltage due to throwing on the load in sudden steps, the fall in the latter case being due to the ohmic resistance of the cell, and possibly, to a less extent, to polarisation.

In a battery working in parallel with a shunt-wound generator at such a speed as to give about the mean output, so that the battery neither gained nor lost very much, the number of cells should be determined by the formula, No. of cells $= \frac{\text{line volts}}{2{\cdot}08}$. I have found that, when in the best condition for working in this way, a battery capable of giving 450 amperes for one hour, will discharge 200 amperes with a fall of pressure of 25 volts, and will charge 200 amperes with a rise of pressure of 25 volts, these limits being the greatest permissible on a 500-volt circuit.

With compound-wound generators, the pressure rises with the load, so that the battery working in parallel with the generator will do very little work.

In working a battery in simple parallel with shunt-wound generators, it is impossible to charge the battery during working hours, and at the same time have it available to discharge on any peaks; this is a great drawback, and necessitates running longer hours to complete the charge.

The only way to work a battery on a tramway or other variable load to keep the generator output constant, to fully charge during working hours, and to discharge up to its momentary rate, is to use some device to compensate for the variation of the battery pressure. For this purpose I have used a booster of somewhat special design, the booster armature being always in series with the battery. This machine is run throughout the time the generators are working, and sometimes when the battery alone is working the line. The essential connections are shown diagrammatically in fig. 9, and the machine itself in fig. 10; this shows the booster driven by a motor, it might, however, be driven from the main engine. The booster B (figs. 9 and 10) has laminated field magnets, excited by a fine wire coil C (the exciter coil), consisting of such a number of turns of such resistance that the pressure given by the armature when run at constant speed is the same as the pressure across the ends of the exciter coil. The exciter E is a small generator giving 500 volts, and the necessary exciting current. This generator has a very small drop from no load to full load, which drop is corrected for by a series winding; its armature leads are coupled, one to the battery negative terminal, the other (the positive) to the positive battery terminal, by way of the exciter coil C. So long as the exciter and battery pressures are equal, no current will flow in the exciter coil, and hence the booster

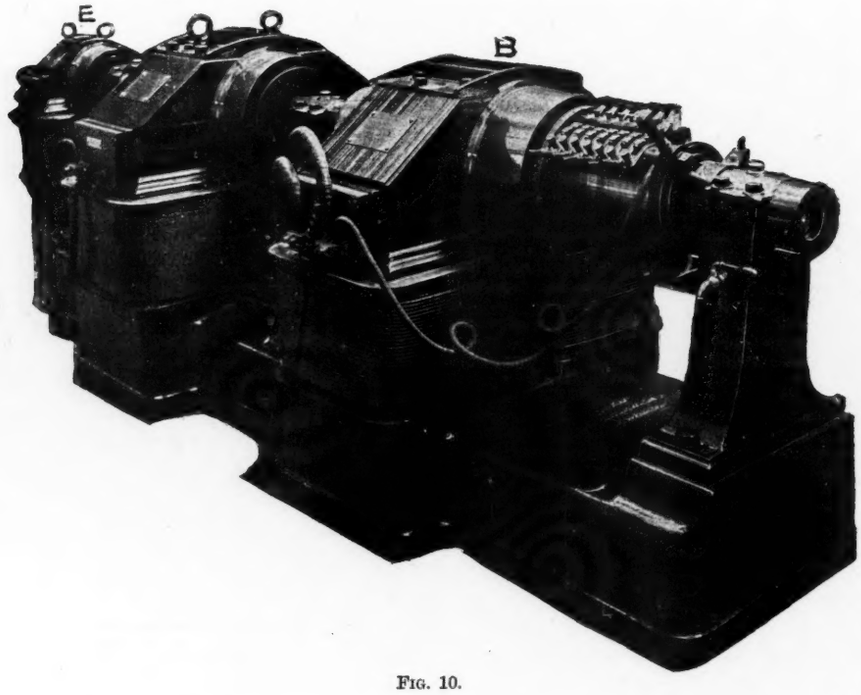


Fig. 10.

variations in the battery pressure must be small, which would necessitate working the battery at a much slower rate than the one-hour rate allowed for above. The ideal arrangement would be to run the generator at constant load, making the constant load as nearly the full load of the generator as possible, to work the necessary number

will give no pressure, but should the battery volts rise a current will move in C proportional to the difference of the pressures of the battery and of the exciter (which will be motored). The booster armature will then give a pressure equal to the rise of the battery pressure. Similarly, should the battery pressure fall, the booster will give a

pressure equal to the fall, but will have its poles reversed, the exciter running as a generator and giving current to the battery. The booster therefore follows the variations of the battery pressure from the line pressure, and corrects for the variations, so as to maintain the line pressure constant whether the battery be charging or discharging. Generally, as will be readily seen, the exciter runs as a motor when charging, and as a generator when discharging, but since only 240 cells are used, occasionally, when the cells are low, charge begins at a less pressure than the 520 volts on the line, the booster then runs as a motor, and the motor as a generator, returning energy to the line; also when the battery is fully charged, the pressure is generally greater than the line pressure. Should the battery in this condition be called on to discharge, the booster opposes the discharge, and is motored; the motor then runs as a generator, and again returns energy to the line. The current variations in the motor amount to about 7 per cent. of the maximum line variation. The booster fields being laminated, and being designed to work at a low induction so that the field strength is as nearly as possible proportional to the magnetising force, the change of polarity is rapidly made, and the booster pressure varies very closely as the difference between the battery and exciter pressures. Such a booster connected in series with the battery will serve to maintain nearly constant the load on the generator, as it will nearly correct for all changes in the battery pressure. There will be times, however, when the current through the booster armature is large and the field very small; the armature reaction will then be an important factor in the working of such a machine. To overcome this, a coil connected in series with the armature is used, so that it opposes the reaction of the armature in whichever direction the current flows: this coil consists of a few turns only. In order to increase the pressure as the load on the line increases a part of the feeder current is shunted round a coil on the booster field in such a direction as to help the discharge or to oppose the charge, or a part of the feeder current may be taken round the exciter fields so as to raise the exciter pressure, or a part of the feeder may be taken round the motor fields, so that the greater the load becomes the greater is the motor speed, and hence also the exciter and booster pressure in the discharging direction. In working with shunt-wound generators there is a tendency for the motor to hunt, so that as the line load increases the battery does more than its share, the pressure therefore rises, and the motor runs faster; the booster pressure increases and the exciter pressure, and hence the tendency is to take still more load; a similar action occurs as the line load falls off. I have overcome this trouble by designing the motor so that an increase in pressure at its terminals strengthens the field in a greater proportion than usual by designing the motor field on the same lines as the booster field; the result is entirely to check the hunting. The switch gear used with the booster is shown in fig. 9. The switch, S, connects as shown on the diagram: in its upper position the battery is directly on the line, in the lower position the battery is connected through the booster armature; F is a shunt-breaking switch and fuse in the exciter circuit.

(To be continued.)

PHYSICAL SOCIETY.

Ordinary Meeting held June 14th.

Prof. S. P. Thompson, President, in the chair.

A Paper on "Herr Jahn's Measurements of the Electromotive Force of Concentration Cells," was read by Dr. Lehfeldt.

Prof. D. Jahn has recently published measurements of E.M.Fs. of concentration cells, from which he has endeavoured to show that the law of dilution is applicable to strong solutions. The author points out that his conclusions are based on argument in a circle, because Ostwald's law is assumed in the formula used by Jahn for calculating degrees of concentration. The formulæ of Nernst and Arrhenius do not yield consistent results, and it is suggested that the former is suitable for calculating concentrations, and the latter for calculating osmotic pressures.

A Paper on "The Mechanism of Radiation" was read by Mr. J. H. Jeans.

This paper contains an attempt to obtain answers to two questions: (1) What inferences can be drawn as to the mechanism by which radiation is emitted from an examination of the formula of physical optics; and (2) is it possible, with the help of these inferences, to frame any conception of matter which will give a consistent account of the various optical phenomena. Starting with general spectroscopy, the author has written down the radiation due to a single rotating molecule vibrating harmonically. The effect of a number of molecules is deduced, and it is shown that the condition that the continuous banded spectrum shall be absent, is that either the period of rotation must be large compared with the period of vibration, or the radiation from a molecule must be spherically symmetrical. Passing on to dispersion, even if the radiation is continuous between collisions, there will be a discontinuity at every collision, and the train of waves will be no longer regular. It is customary to assume that the vibrations of a dispersing medium are sympathetic with the irregular incident light. The author has calculated the ratio between forced and free vibrations in a prism or grating, and finds that if the dispersion is to be regular the vibrations must be only slightly influenced by collisions, and this requires, as in the former case, that either the period of rotation is large compared with the period of vibration or the radiation is spherically symmetrical. As this is not the case with molecules, the author thinks that the line spectrum is emitted by atoms, that these atoms must be dissociated, and that the shape of these atoms is one of spherical symmetry. It is shown that if an atom is an electro-magnetic system, similar to a planetary system, then the periods of such an atom would not be fixed, and there would be no reason for a line spectrum. The normal atom is, therefore, regarded as an electrostatic system, with some law of force other than the inverse square law, holding at interionic distances. Such an atom, when at rest, would give a pure line spectrum. Rotation of such an atom causes the lines of the spectrum to shift towards the red, and as the rotation is different for different atoms, the lines will not only be shifted but broadened. To calculate the periods of vibration of an atom, the author has assumed it to consist of an infinitely great number of infinitely small ions. The spectrum of this consists of a collection of spectrum series, each possessing a definite head and capable of explaining doublets, triplets, &c. It is shown that under the action of a magnetic field a line may separate out into approximately equidistant lines, the central lines maintaining its position. In conclusion, the author points to many other physical phenomena which can be explained by the theory described.

The Society then adjourned until June 28th, when the meeting will be held, by the invitation of Prof. W. G. Adams, in the laboratory of King's College.

INDUSTRIAL BETTERMENT.

In a recent issue of *Cassier's Magazine*, Mr. H. F. Porter, of the Bethlehem Steel Company, South Bethlehem, Pa., contributed an article on "Industrial Betterment" in the iron and steel industry; as many of his suggestions may be equally applied to all manufactures, they may be worth the consideration of those engaged in electrical industries.

The conditions existing in the early days of iron and steel manufacture are not those under which electrical manufactures have been developed in later times. In the nineteenth century it was not possible for electrical industries to form guilds and keep trade secrets, which could only be handed down from father to son, or to apprentices who, under penalty of death, were forbidden to disclose the details of their trade.

Mr. Porter proceeds to show that strikes and lockouts were the result of the light of science breaking through the darkness of the times, and these conditions we allow with much regret are still with us, notwithstanding the advance of civilisation. Following Mr. Porter's reasoning, we think we are right in expressing the opinion that the greatest source of real pleasure in this life is to be found in benefitting our neighbours, and in his own words, "not by indiscriminate charity, but by showing men how to help themselves, and lending a helping hand where necessary."

In large electrical enterprises, as well as iron and steel industries, thousands of men are employed of various intellectual capacities, from labourers upwards, and the real difficulty in all labour questions is the differentiation necessary to properly determine the capacity of the human units for intelligence and industry. Take for instance, the labouring class who are paid by the day; here we have old and young, weak and strong, irrespective of the useful work performed by each, paid on the same scale.

We consider that at the present day this condition has brought about the regrettable result of most employers of labour arriving at the conclusion that the young and strong men render better paying results than the more experienced and older men, who may not be equally strong, but through steadiness of character and experience would, in many cases, prove equal in the long run.

Though we are not able to resist the "survival of the fittest," we may make a mistake when we unthinkingly practise the "survival of the strongest" as resulting in the same effect.

If it were possible to measure human capacity in a somewhat similar manner to the measurement of electrical capacity, then the management of workmen and their wages would be comparatively easy; but intelligence and capacity, or industry are not to be measured in volts and amperes, so there must always be the effect of the personal element in the organisation of works and management of men.

The system of trade unions of trying to enforce the equality of men is an attempt to defeat "the survival of the fittest," and this result cannot be attained; the system must always result in dissatisfaction and discontent. Only when employers and employed can be brought to realise that their interests are line and line, not antagonistic, will labour troubles, strikes, lockouts, &c., be done away with.

Mr. Porter points out that a scientific, conscientious system of management based on a combination of what Huxley describes as two opposing methods of government—*i.e.*, the cosmic and the ethical—is sure to bring about results favourable to both employer and employé.

He says that "the employer must feel that the question is not 'What salary *must* I pay?' but 'What *ought* I to pay?'" and we add that the employé must realise what is his market value, and be content to render an equivalent in intelligent work.

Mr. Porter goes on to say:—"It is plainly the duty of the intelligent employer to institute a system of payments by which each individual shall be paid according to his merits. Much time

and careful observation must be directed to the establishment of a fair day's work for the normal man, as well as the rate of payment for it, and a generous bonus should be given to all who exceed the stated amount of work. To bring this about, however, requires much skill and patience, a kind and generous nature, and a sound judgment. A wage rate, once established, must not be changed whether the times are good or bad, otherwise the men become disheartened, fearing a cut in their pay."

Now we are unable to say whether Mr. Porter has put the above system in practice, for the article does not state that he has found it practicable and eminently satisfactory, but we feel confident in saying that if any employer were to give a "generous bonus" or to increase the average workman's wages without his having had to apply for a rise, he would soon find that the workman, instead of considering that he was only receiving a fair recognition of his services, and applying himself even more energetically to his employer's interest, would either come to the conclusion that his standard wages were on too low a basis, or that he was considered by his employer so indispensable that it was advisable to make him a present to retain his services.

Mr. Porter's ideas seem to be all derived from a very happy theory, which reads very well, but which any person who has had an opportunity of studying the character of the working man must see is more of a fairy tale than a possible solution of the difficulties between employer and employed—something that might pass through the mind on a Sunday afternoon, say.

He goes on to explain that this fair-wage and bonus system will stimulate the best workmen, and that the others who either cannot or will not work will soon drop out, but it is evident that in this case the trades union has been ignored.

Another important point suggested by the author of the article is "that a place once earned by a man must not be forfeited by favouritism," and this is, indeed, a sore point with those who try to do a day's work for a day's pay; there is no necessity to give instances of this injustice, it will be a familiar case with all readers. Again, to quote from the article "There is nothing so conducive to a man's peace of mind as the knowledge that his occupation is steady and his income sure." We should be glad to hear from any employer of labour that he had found his men to apply themselves better to his interest under the conditions stated.

We consider that the system obtaining in some, if not all, parts of the United States, of taking on workmen without reference or agreement, and discharging them without notice or character if not up to the standard expected, has a much more stimulating effect upon workmen, but this system can only exist in countries where the trades union and other circumstances permit; we neither approve nor advocate it, as it can only render a man more like a machine than an intelligent member of society with a well brought up family and a comfortable home.

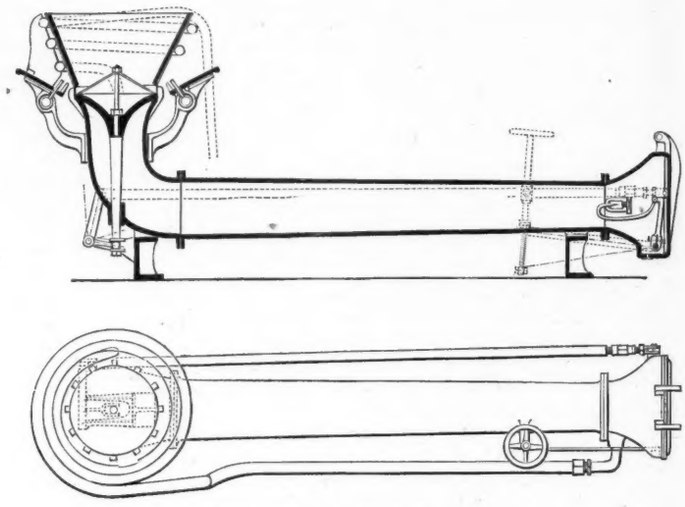
We have not space to spare for a further examination of the article, but we cannot conclude without saying that the whole scheme, while it looks very pretty on paper, and reads something like a *tract*, lacks the practical consideration necessary for the solution of such problems.

We have never known of cases where privileges have been granted to even a small number of men, without one or more finding means of abusing them. A point touched upon, which, we think, does not receive sufficient consideration with employers, is the attention to light, heat, ventilation, dining rooms, and lavatories, and we think no one will dispute the assertion that a workman whose surroundings are comfortable and convenient will do more work than one having an ill-lighted, draughty, dirty environment.

200-H.P. CLARKSON OIL BURNER.

We were present on June 10th at a very successful demonstration trial of a large Clarkson oil burner, at the works of the Clarkson Capel Steam Car Syndicate, of Deverell Street, S.E. This particular burner has been constructed for a water-tube boiler, to be placed on one of the fire floats of the London Fire Brigade, which has had for a year a land engine heated by the Clarkson system, and has, as a result of the satisfactory performance, decided to apply it to the fire float.

In the Clarkson burner, which is really an oil Bunsen, oil under pressure is forced round a coil that is heated by the flame, and it escapes as a vapour at a nozzle at one end of a long trumpet. The outlet is regulated by a taper spindle. The oil vapour draws in air, and is well mixed with this in the long trumpet, and finally escapes round the opening of a flat-faced valve, being there ignited and burned. This flat-faced valve is movable simultaneously with the above-named regulator spindle, and thus always provides for a constant efflux velocity of the vapour and air; this guards against back firing. By regulating the air admission the oil can be burned either as a perfect Bunsen blue non-luminous flame or as a solid or white flame with radiation effects. The combustion is perfect and the heat intense, and the test was eminently satisfactory. Smaller burners have been made for some time for steam cars, but nothing so large as this 200-H.P. burner has yet been made. It demonstrates that oil fuel can be employed over a wide range of powers from small steam cars, launches, and even the harmless domestic kettle, up to units of 200 H.P., and we should say even considerably larger units could be employed. The initial heating of the vaporising coils can be effected by means of methylated spirit, or, as shown at the test under review, by means of gas. As soon as started, no matter how feebly, the oil flame rapidly heats up the vaporising coils, and full power is produced. Thus in the fire engine full power for the engine is obtained in 2½ minutes after call, a result never yet attained with coal firing. The 200-H.P. burner is designed so as to be capable of being worked with a very small flame, so as to keep the boiler under gentle steam. Under these circumstances, the signal for full steam can be answered almost immediately, the simple turn of a hand-wheel putting the burner into full combustion at once.



Plan and Section of Burner.

The details of the burner are readily seen from our illustration, and the connection between the burner valve and the admission regulator can easily be traced out, as also the vapouriser coils. The demonstration was a decided success, and should extend the range of application of oil-burning steam generation.

CHANGING OVER.

[COMMUNICATED.]

A large number of central station engineers have recently found it advisable to raise the pressure of supply. This has been done as a rule to increase the lamp capacity of the distributing network and to reduce the drop in the voltage. Taking advantage of the increase in the pressure limit permitted by the Board of Trade, many alternating stations have changed over to direct current with 460—500 volts across the outers.

According to the latest returns there are at present about 217 central stations in the United Kingdom, of which 84 are alternating with a total capacity of about 88,000 KW. and 133 direct current with a total capacity of 132,000 KW. Of these some of the stations started as alternating, and have changed over completely to direct, and others have changed to direct current for the central area, retaining the alternating current for the outlying districts.

There is a growing tendency on the part of engineers to put down direct current stations. Many large American stations with an output that puts any station in this country into the shade, supply direct current at 100 volts, and if these large stations can be operated satisfactorily at 100

volts, it stands to reason that smaller ones can be run successfully at 460—500 volts.

Without wishing to hold up American practice to be followed blindly, it must be admitted that electrical undertakings are farther advanced in that country than in this, and that if alternating current were all that its devotees paint it, more would have been done in that direction by American engineers.

Modern practice in distribution all seems to point to direct current supply; though in some instances the current is generated alternating either two or three-phase, and transmitted to substations in the area to be supplied, and there transformed to direct current either by rotaries or motor-generators.

The advantages of direct current over alternating may be briefly stated :—

1. Direct current works at its lowest efficiency during the hours of full load, which is about three hours out of the 24, and consequently is working at its best during the greater part of the day, the reverse being the case with alternating.

2. Direct current street lighting is much more satisfactory and economical than alternating.

3. Direct current motors are more efficient than alternating, and will start up easily with full load, which is a point to be taken into very serious consideration in a manufacturing town where there is likely to be much demand for power.

4. In the direct current system there are no transformers to break down, or H.T. fuses to give trouble. In fact, the fewer fuses on a direct current system the better.

5. The direct current system is easier to work at the station. In paralleling machines the voltage only has to be watched, and there is no getting a machine in out of phase, as in the case of alternating current.

6. There is much less risk of danger to the attendants from shocks, and less liability of the insulation of the machines, mains, and apparatus to break down.

A point often brought up against direct current is the commutator. A commutator seems to have great terror for some alternate current men (perhaps because the unknown is always fraught with terror to the timid mind) but in modern well-designed machines with carbon brushes, the commutator gives very little trouble if looked after with ordinary care.

Having decided to change over to direct current, there is a busy time in store for the engineers, and not an entirely blissful one. The proper time to begin the actual changing of the circuits is, of course, in the spring, with the long daylight hours, so as to cause as little inconvenience as possible to the consumers. Each circuit, before it is changed over, has to be overhauled, and unsuitable switches and fittings exchanged for those of high-voltage pattern. Many installations, where the work has been up a long time, require to have practically the whole of their fittings renewed. Switches that were all right for 100-volt alternating current supply, sometimes are the reverse with direct current at 230.

Switches and fuses with metal covers are especially troublesome in this way. It is a good plan to put the fuses in asbestos sheaths, as when the fuse blows, this smothers any tendency to arc. Double-pole fuses on the same base should never be allowed.

Miniature lamps, used for decorative purposes, are very undesirable on high voltages, and, where possible, it is better to wire two such in series. All the motors, arc lamps, cooking, heating, and other special apparatus, including, of course, the meters, have to be exchanged.

Changing the motors is usually not a very large matter; as a rule there are not many of them, and what there are are usually small sizes.

The arc lamps are sometimes rather a difficulty. With alternating supply a single arc lamp at an installation is often met with, and it is not always easy to persuade a man that he wants four lamps in the place of the one he used before. Single enclosed lamps do not work well across 250 volts. Although two in series do not burn so badly, yet they do *not* give so good a light as open type lamps, and consumers often, with the same reason, object to them.

The arc lamps in theatres, used for lime-light effects, present rather a difficult problem, as they must be able to be used singly, and there appears to be only three courses open. (1) To instal a continuous current transformer in the theatre itself, to reduce the voltage from 250 to 50. (2) To leave the arcs alternating. (3) To insert a large resistance in series with each lamp.

The first-named is the best plan, although it is attended with a good deal of bother, as the supply authorities are usually responsible for the upkeep of the C.C. transformer, which will not probably be looked after by the theatre people with any very great care.

If the outlying districts are still supplied with alternating current, the second plan is the simplest, but it establishes an objectionable precedent, and as it is probably the engineer's object to ultimately do away with alternating current altogether, it is merely putting the evil day off, and the problem will have to be faced again later on.

The third plan has the objection of requiring a large number of resistance coils, and if the resistances are not to get dangerously hot, a *very* large number will be required, and, as a rule, there is not too much available space in the basement of a theatre; or a liquid resistance may be used, with the accompanying inconvenience of fumes, and uncertainty in working.

Heating, cooking, and other small apparatus all have to be changed, but do not give much trouble. Another source of trouble is the mains themselves. Although they may stand all right with 200 volts, faults often crop up when the pressure is a little more than doubled, and the best way to deal with this is to put in very healthy fuses, and let the faults burn out as they occur.

It is surprising what a lot of cable can be burnt away through a comparatively small fuse. A case recently came under the writer's notice in which a fault occurred on a network of two 37/15 and one 19/15. The circui twas protected by a fuse of two strands of 16 copper on each outer. When the fault was dug up it was found that one of the 37/15 was burnt in two and the other nearly so, and the 19/15 had disappeared entirely for about 2 yards. The fuse had simply melted in the middle, and there had been no arcing at the contacts at all.

Passing from the legitimate troubles incidental to changing over, there is always the trouble of the consumer who objects to the higher pressure. As a general rule, the inducement of having the installation overhauled free of cost, and a new outfit of lamps for nothing, is sufficient to silence any objections, but here and there a consumer crops up who, either out of sheer cussedness, or because he has, or fancies he has, a grievance against the supply authorities, absolutely declines to have the increased voltage, and in some cases a special main has to be laid for the sake of one or two consumers.

It is a very difficult matter to know how to deal with these "conscientious objectors," but recently the Government has so far taken pity on the supply authorities as to sanction the matter being put to the arbitration of the Board of Trade.

When, however, the change-over has been completed, the simplicity in working will more than repay the trouble and expense in carrying it out.

STREET LIGHTING.

By A MUNICIPAL ELECTRICAL ENGINEER.

The best method of street lighting is undoubtedly by means of electric arc lamps. The lamps should be spaced about 30 yards apart in the busy parts of a town, the distance being increased to 40 or 60 yards in the less frequented districts.

Street arc lighting is not carried out to anything like the extent it should be in this country, and it is comparatively a rare thing to come across a town with as many as 200 public arc lamps. The lighting authorities usually object on the score of expense, saying that it is cheaper to light with gas, and so, no doubt, it is for such light as it gives, but light for light there is nothing cheaper for public illumination than arc lamps. The lighting of many of our large towns is perfectly disgraceful, the streets being in semi-darkness after the shops are closed.

Where the electric lighting is in the hands of the municipality the current ought to be supplied for public lighting at cost price per unit (that is, after interest and sinking fund have

been allowed for) with the addition of about 7 per cent. to cover the cost of attendance and depreciation. The public lighting should be done as cheaply as possible, and having a lot of good street lighting makes a very good advertisement for the undertaking, but it ought not to be made cheap at the expense of the private consumer.

Arc lighting ought to be adopted along all the main streets, the small streets being lighted by incandescent gas. Incandescent electric lamps are not to be recommended for street lighting; they do not give enough light for the money paid for the current, and streets lighted by their means never look well for the simple reason that there are never enough lamps fixed. Wherever possible the arcs should be run in two circuits, the lamps going on alternate standards from each circuit. After midnight half of the lamps can be turned out, which is much better than putting on incandescents in the place of the arcs for the lighting during the early hours.

There are many ingenious devices for switching arc lamps on and off automatically with time switches—which, however, do not always work—and for switching the incandescents on when the arcs are extinguished; but these automatic arrangements are better dispensed with if any other satisfactory method can be arrived at.

For successful working the system should be in the charge of a thoroughly competent foreman, to whom the trimmers are responsible, and who should make a written report every day to the station manager, giving the time the lamps were switched on and off on the previous evening, the numbers of the lamps that were out, the cause and the length of their failure. It should be the duty of one of the trimmers to go round the circuits as soon as the current is switched on, and again later on in the evening to see that all the lamps are alight; and if a small bonus is given every month to the trimmers, provided there have been no unavoidable failures during that time, they will soon be very careful in trimming the lamps, which is half the battle, and failures will be of rare occurrence. The globes should be cleaned every week, as nothing spoils the effect of good lighting so much as dirty globes.

The principal methods of arc lighting in vogue are:—(1) Constant current series; (2) constant pressure series parallel, both alternating and direct current; (3) rectified alternating current with the lamps in series.

Constant current series arc lighting is not in very great favour in this country. To start with, although the efficiency of the series arc lamp is higher than that of the parallel type, the efficiency of the series arc-light dynamo is lower by about 10 per cent. when new than that of a good constant pressure machine, and falls off very considerably with the age of the dynamo, whereas the efficiency does not fall off appreciably with the constant pressure type. Apart from the efficiency of the machine itself, with series arc lighting, if a lot of lamps are in use, a large number of small dynamos have to be run either with separate engines to each machine or by countershafting from one larger engine, and here again is a considerable loss of efficiency. The commutators of arc lighters frequently give a good deal of trouble with flashing over, and some machines, after flashing over, lose their current and have to be excited by shorting the fields before they will pick it up again. Flashing over, too, is very liable to make the carbons of some of the lamps lock, thus putting them out.

With a large number of lamps in series, there is always the danger of failure due to the high pressure wires passing up the lamp standards. There is also the liability of all the lamps on a circuit being out because of a faulty connection on any one of the series, and one defective lamp will, to a certain extent, cause the whole lot to burn badly.

When, however, everything is in good order, the lighting effect from series arc lamps is very good, and in many towns in America a large number of them are in use; in one city alone there are as many as 7,500 series arc lamps, which goes to show that series arc lighting can be made very satisfactory. On this side it is the usual practice to run the public lighting from the same machine as the ordinary lighting, and this method certainly has many advantages.

In the case of alternating current stations the lamps may either be taken at different points from the low tension network, and switched on at different places in the town, or a separate main may be run with a transformer to each lamp or group of lamps. The latter method has the advantage that all the lamps can be switched on at once from the station, but it involves a large number of small transformers, which are not so economical as large ones, and which form an objectionable feature, as, in addition to being uneconomical, every such transformer is to a certain extent a weak point in the system. When small transformers are used in this way for arc lamps, they are usually placed either in road boxes or in the bases of the lamp standards, neither of which is a particularly desirable place for high tension apparatus.

Where the lamps are taken from the low tension network, two can be run in series with a choking coil in circuit off 100 volts, and the light, though not so good as from a direct current lamp, is very satisfactory.

With the direct current three-wire system the arcs may either be taken four in series across one of the outers and the middle wire, or nine in series across the two outers, from the ordinary lighting mains or from a separate main run specially for them. The latter method is not open to the same objections as in the case of the alternating current, as there are no small transformers to waste energy and to be a source of weakness in the system. It simply resolves itself into a question of expediency whether a separate main shall be run, or the lighting be taken from the ordinary network. If before the question of street lighting has arisen lighting mains of ample capacity have already been laid, it probably will not be worth while to go to the trouble and expense of opening up the ground again in order to lay cables specially for the job, but in the case of a new station being put down, or if the streets are up for repairs or any other reason, it is certainly the better plan to lay separate mains for the arc lighting if there is to be much of it.

The lamps should be run four in series between the outers and middle wire, a switch and fuse being placed in the base of the first pole of each group, so that in case the lamps require attention when the circuit is on, the current can be cut off from the group if necessary. A single-pole switch is all that is needed; this will, of course, be on the outer, as the middle wire is at earth potential.

Very few circuits would have more than 100 lamps on, so the mains required are not very large. With 100 lamps four in series 125 amperes would be the current across the outers, so that the mains would start with two 37/15, and one 19/16 gradually reducing to 7/16 at the end of the circuit, the drop of pressure being allowed for, if necessary, by adjusting the resistances placed in series with the group of lamps. If the lamps are run nine in series across the outers, the middle wire, of course, will not be required. It is better to run them four in series, as they burn better that way, and in the event of a fuse going the area affected is smaller.

The resistances, which can be made very cheaply at the station, should be placed either in the bases of the standards or at the top near the lamps in cast-iron boxes, at which distance from the ground they are not at all noticeable. The latter plan has the advantage of keeping the resistances cool.

Street lighting by enclosed arc lamps, whether alternating or continuous, is not to be recommended. The inner globes frequently give a good deal of trouble by breaking, and if they do not break they get blackened and cut off a large percentage of the light a long time before the carbons have burnt out. At their best they are not nearly so good as open-type lamps, and should not be used except perhaps in the case of direct current, where it is difficult to arrange for more than one standard in a particular place, and then it is preferable to have two lamps in series on either side of the standard, to having a single lamp across 200—250 volts.

With rectified alternating current about 40 lamps can be run in series from each rectifier, assuming the primary current is at 2,000 volts. Very different opinions are expressed as to the satisfactory working of rectifiers at different stations. At some they work very well, but at others there is endless trouble with them. The current derived from them is unidirectional but intermittent, not continuous, and the lamps hum to a certain extent in the same way as alternating lamps. The system is open to some of the same objections as the continuous current series arc

lighting, in that a broken connection on any one lamp puts all the circuit out; there is the same danger of earths due to the high potential at the lamps, and there is the additional apparatus at the station requiring special care. There are many very good alternating arc lamps on the market now, and it seems scarcely worth while to introduce further complications into the working of the station, by having rectifiers with all the troubles attendant upon high voltages, when very satisfactory lighting can be obtained without their aid. Of course, it makes fresh experience for the engineers, which, in the writer's opinion, is one reason why there is such a diversity of plant to be found in many of our central stations.

SNOW CLEARANCE.

Now that summer has come, we can talk of snow with equanimity. While winter was with us the presence of the snow itself, with all its discomforts and inconveniences, was quite enough to make one loathe the thought of writing about it. In more severe climates, where many feet of snow fall regularly every year, any road which does not contemplate shutting down altogether for weeks at a time, must be equipped with powerful ploughs and brushes driven by motors. The number of these special cars which a road will have, depends, of course, on its magnitude. In 1900 the Ottawa Street Railway Company spent a sum equal to 1½ per cent. on its capital for the removal of snow, and in Montreal the total cost of dealing with the snow during the winter equalled 3 per cent. on the capital of the company*.

In many cities where the fall of snow is large, the snow has to be entirely removed after it is ploughed or swept from the tracks, and in some American towns ordinances compel the street railway companies to level off the snow, which otherwise would remain banked on either side of the track. Again, in some parts, snow may be deposited only on one side of the track.

Snow fences are utilised very largely on country lines in the States, especially at those points on the line where the conditions are favourable for the formation of drifts. Fortunately for us, we do not experience every year, or for any length of time, such rigorous weather; and, for that reason elaborate snow-clearing devices do not form an integral part of the equipment of our tramways systems; in fact, we are, or have been, too generally totally unprepared for any considerable fall of snow when it has come. In large towns and cities where there is heavy and continuous traffic, and at the same time a short headway between cars, a fall of snow which would stall the cars on a line in a comparatively quiet district, will not cause any inconvenience or require to be cleared, as it will be converted quickly into slush, and will not harden and pack in the rail grooves because of the rapid succession of car-wheels.

In fact, a snow plough should be required very rarely inside a large town. On the first sign of snow coming to stay, or even before, salt or brine should be sprinkled along the rails from a car. If the melting slush and new snow threatens to become troublesome, the brine ceasing to have any appreciable effect, the time will be ripe for sweepers, and gangs with carts must be sent out to remove the accumulation. This carting away of the snow is the most expensive part of the business.

Coming back to general principles, it is very necessary to *anticipate* a snowstorm, especially the first of the season. While the sun still shines have the ploughs made, or thoroughly overhauled and strengthened where last season's experience showed weakness; get the salting arrangement into working order, and organise a staff of men for fighting the snow when it comes.

The foolish manager is he who sits in his office till the first snow arrives, and seeing it, still sits there wondering if it is going to last. He is stirred from his supineness when an inspector drops in to say that the cars are stalled on such-and-such a route, and then rushes about giving red-hot orders, sending for men, sending for the plough, for the salt, for brushes, for everything at once. Something is sure to be out of order, and will need repair before it can be used. Perhaps there is no salt in stock, and it is certain that men cannot be collected in five minutes. Finally, when everything is ready, the snow is an inch or several inches deeper; the plough has hard work to get to the blocked route, and when it gets there finds stalled cars which have to be shifted, or on to which the plough has to be fixed, before the clearing can proceed. By the time the service is running again, enough revenue has been lost to have paid for all the anticipatory preparations which should have been made.

As the average snowfall in England is not sufficient to warrant a special ploughing and sweeping equipment, it is usual to make small ploughs which can be pushed by an ordinary car.

For several reasons it is necessary, or advisable, that the plough should not project beyond the end of the car, so that its height is limited by the clearance between rails and any essential fixture under the platform. It will be expedient, probably, to remove the step and life-guard, and, as this will take time when time is most precious, as many cars as there are ploughs required should be withheld from service and made ready whenever a snowstorm is expected. It will pay better to reduce the service for ploughing in time than to have the whole service stopped for lack of ploughs.

Ploughs on the old steam trams were often merely vertical boards set at an angle of 45° with the track, and fixed to the front of the dummy.

If the authorities will not permit snow to be piled on both sides of the road, a modification of this form of plough must be adopted, and it should be made so that it can run on the top or bottom, as it must be turned over when the direction of travel is reversed; unless the strut can be hinged at will on either end of the plough proper, in which case the plough may be shaped somewhat after the style of an agricultural ploughshare.

The best form, of course, is the sharp-nosed, equal-sided plough, half the snow being thrown on either side of the track.

The sides of the plough should be set at an angle of about 30° from the perpendicular, and should curl over on the top edges, so that the snow is screwed off the ends of the plough and runs further than it would if the plough was wall-sided. Moreover, less power is required to force the former type through snow. The nose must be heavily armoured, and rounded off to enable it to jump any unevenness in the track. If the life of the plough is considered, special wearing "runners" of double or treble-shear steel from ½ in. to ⅜ in. thick should be rivetted on to the shears. These runners are shaped with advantage to the contour of the track; otherwise they will not scrape the rails till the parts which touch the setts or macadam only are worn down.

The shares must be well strutted and tied to prevent crushing and spreading.

The attachment of the plough to the car will vary according to the circumstances. Where a straight "guard-plank" is fixed at each end of the truck, it may be utilised very conveniently. Two short chains are fastened securely on the shares, and these are pinned into eyebolts let into the ends of the guard-plank. Brackets on the inner side of the shares butt against the ends of the guard planks, taking the push, and the chains prevent any serious movement except lifting. The shares can project about 18 in. outside the rails. As it is unpleasant to handle the iron work of the plough when changing ends, a D link can be fastened through the nose, and a large eye at the end of each share; forged hooks attached to ropes or leathern thongs being used to haul the plough about. The whole operation of changing from end to end should not exceed three minutes when the men are in practice. On a heavily-graded road one car will be unable to push a plough quickly enough through more than a few inches of snow, and a second car will have to be requisitioned. This coupled car will be called upon to do most of the work on severe grades, as the thin layer of snow left on the rails by the plough causes the wheels of the front car to slip.

For that reason some arrangement of brushes, which can be pressed on to the rails behind the plough, is of service. To make a clean wet rail for the following car, it is well to

* *Street Railway Review*, Vol. xi, January 15th, 1901.

drop salt on both sides. As the effect of salt is felt very heavily in the repair department, and as its use is generally forbidden more or less strictly by the authorities, it should be sprinkled sparingly, and not thrown over the front of the car with a shovel.

An easily-made salting apparatus consists of a box with sides tapering from 18 in. to 6 in. at the bottom, placed in the middle of each longitudinal seat, having a 1½-in. pipe fastened to the bottom by a nut on each side, and running straight through a hole cut in the floor to within an inch or two of the rail. A bar of flat iron, twisted to form a quick screw, with one end forged into a spindle, taking a bearing at the top of the box, goes through the box to the bottom of the pipe.

Salt will not run through the pipe unless the screw is moved, and its rate of egress can be regulated very nicely.

One man can work two of these salters if they are suitably connected.

No more than three men are required on a ploughing car, one to drive, one to salt, and the third to watch the trolley pole, replenish the salt boxes, and adjust the rail brushes.

If snow is persistent, hilly lines on which a moderate service is worked cannot be kept clear, *i.e.*, the usual service cannot be run without delay, unless there is a plough to every three miles of track.

Business men want to travel, and to travel punctually, whether it snows or is fine, and it should be the aim of every manager to keep schedule time, whatever the conditions may be. On too many lines the coming of snow is accepted as the signal for the preparation of the plan of campaign, instead of being watched for and met by a fully-equipped corps of fighters.

CURRENT SPECIFICATIONS.

LXVII.—MANSFIELD LIGHTING AND TRACTION PLANT.

SUMMARY.

Extent of Contract.—Equipment of an electric lighting system with provision for use for traction purposes hereafter.

Division of Contract.—Contract to be divided into 10 sections as follows:—(*a*) Boiler house plant; (*b*) engine room plant; (*c*) condensers; (*d*) switch gear; (*e*) cells; (*f*) crane; (*g*) mains; (*h*) public ighting plant; (*i*) meters; (*k*) workshop equipment.

System Adopted.—Three-wire direct current system, with accumulators, the pressure at lamp terminals being 240 volts.

Type and Number of Boilers.—Three to be supplied of Lancashire type each 30 ft. long by 8 ft. diameter, and capable of evaporating 7,000 lbs. of water per hour when working under natural draught, and supplied with feed water at 60° F.

Working Pressure.—150 lbs. per square inch, but boilers to be suitable for working at 180 lbs.

Type of Mechanical Stokers.—To be of Bennis, Proctor or Meldrum type with all necessary accessories.

Size of Boiler Feed Pumps.—Two to be provided of Hall, Weir, or equally good make, each capable of pumping 1,400 gallons of water per hour against a boiler pressure of 180 lbs. per square inch.

Method of Working Mechanical Stoker Gear.—An electric motor to be provided capable of working five sets of automatic stoker gear and the scrapers of fuel economiser.

Size and Type of Fuel Economiser.—To be of Green's type, 96-tube size, made up of three groups of 32 tubes each.

Number and Size of Generating Units.—Three to be provided, each capable of developing as normal load 200 KW.

Type of Engines.—May be of any type which have been successfully used in equal or larger sizes for electric lighting work.

Specified Speed.—Not to exceed 400 revolutions per minute.

Specified Overload.—To be capable, when working condensing, of an overload of 20 per cent. for two hours and an overload of 50 per cent. for a few minutes.

Permissible Range of Governing.—Permanent variation not to exceed 5 per cent. between no load and full load. Momentary variation not to exceed 7 per cent. when full load, 1½ per cent. one-tenth load, and 4 per cent. when half-load is suddenly thrown off.

Output of Dynamos.—Machines to be compound-wound, suitable for lighting or traction purposes. As shunt machines to give 200 KW. at any pressure between 480 and 550 volts = 417 amperes 280 volts or 363 amperes 550 volts. As compound-wound machine to give 500 volts on open circuit and 600 volts at full load. Also to give 240 KW. as shunt or compound for two hours, or 300 KW. as compound only for a few minutes without injury.

Permissible Temperature Rise.—When run at 480 volts, not to exceed 60° F. above surrounding atmosphere after 10 hours' run at full load. Rise of temperature to be measured thermometrically.

Specified Steam Consumption.—Not to exceed 26 lbs. per KW.-hour at full load working with 150 lbs. pressure, and 24 in. vacuum. If average of tests of three sets exceeds this amount a penalty of £600 per pound of steam, or *pro rata* to be enforced, and if average below 25 lbs., a corresponding bonus to be paid.

Output of Motor Transformer.—For cell charging to be capable of giving on dynamo side, 150 amperes at any pressure between 20 and 160 volts. Motor to be wound for 480 volts.

Output of Balancing Motor Transformer.—To be capable of dealing with an out-of-balance current of 100 amperes, or on an emergency, 130 amperes.

Type of Condensers.—Three to be supplied of Korting's ejector pattern, each suitable for dealing with 6,000 lbs. of water per hour.

Type of Circulating Pumps.—To be three in number of centrifugal type, each electrically driven, and capable of lifting 20,000 gallons of water per hour a total height of 40 ft.

Size of Switchboard.—To deal with three dynamos, balancer, booster, cells, and arranged for six circuits, to be provided. Board to be in every way suitable for use on a three-wire direct-current system, and to comply with specified arrangement of switch gear.

Capacity of Accumulator Battery.—To consist of not less than 292 cells, the terminal pressure at end of a 10 hours' discharge at 50-ampere rate, being at least 540 volts, and the voltage of each cell not less than 1·85 volts.

Number of Regulating Cells.—Thirty on each half, or 60 in all.

Character of Maintenance Guarantee.—Free for twelve months, an offer to be made on what terms contractor will maintain to 80 per cent. of rated capacity for a term not exceeding 14 years.

Size of Overhead Crane.—To be of hand travelling type, suitable for a working load of ten tons, and a span of 38 ft. 6 in. between rail centres.

Type of Underground Cables.—To be of lengths as specified, triple-concentric, concentric and single, and insulated with impregnated fibre, paper or other approved material. To be suitable for a working pressure of 500 to 600 volts. 250 house service boxes to be provided. Specified lengths of trenching to be included in offer.

Number of Arc Lamps.—Thirty to be provided of 10-ampere size to burn 17 hours without recarboning, five in series across 240-volt direct current mains.

Specified Value of Post.—Not to exceed £14 per post completely erected.

Number of Meters Required.—Two hundred and fifty for consumers' use of a type approved by the Board of Trade.

Specified Dates of Completion.—Different for the various sections, varying from six to ten months from date of order.

Penalty for Late Completion.—One-quarter of 1 per cent. per week of contract price per section for first month, one-half of 1 per cent. per week second month, three-quarters of 1 per cent. per week for third month, and 1 per cent. per week for fourth and subsequent weeks.

Specified Terms of Payment.—Tools, full value on delivery, if satisfactory. Crane and meters, 80 per cent. of value of work delivered and executed on site, 20 per cent. three months after plant has been accepted by purchasers. Rest of sections, 80 per cent. of value of work delivered and executed on site, 10 per cent. one month after plant taken over, 10 per cent. nine months later.

Period of Maintenance.—Until final payments for the several sections are made. See comments later.

Stipulations as to Removal of Foreman.—Satisfactory.

Stipulations as to Wages to be paid to Workmen.—Standard recognised rates to be paid.

Stipulations in Sureties.—Two sureties to be found by contractors for each section willing to be responsible up to 10 per cent. of contract sum for that particular section.

Arbitration Proposals.—Satisfactory.

Date for Receipt of Tender.—July 12th, 1901.

This specification is issued by Mr. Robert Hammond, M.I.C.E., the consulting engineer to the Mansfield Corporation. It provides for the works necessary for the establishment of an electricity supply undertaking suitable for both lighting and traction purposes.

The station will be erected in proximity to, and worked in conjunction with, a refuse destructor station, any available steam from the destructor being used in connection with the electric lighting plant.

It will be noted that the boilers are of the Lancashire type, three in number, and that mechanical stokers and a fuel economiser are to be supplied, and it is satisfactory to find that even in respect to the boiler feed pumps economy in working is preferred to minimum first cost, inasmuch as these are to be constructed on the "Weir" principle. The scrapers of the economiser and the mechanical stoking gear are to be driven electrically.

One of the most interesting technical features in the specification is the size of the main generating units. We consider that Mr. Hammond is right in deciding upon one size of unit, and that the 200-KW. size is none too large for the purpose. It shows how far we have advanced during the past few years to find such a principle advocated and adopted in place of the larger number of small units and the graduated sizes of plant to be seen in so many stations. Each boiler is easily capable of supplying steam to one set. The

engines may be of any type which has been successfully employed for electric lighting purposes, and the dynamos arranged with a series winding to permit of their use for traction purposes. Each set is to be interchangeable as regards parts, and it will be well if tenderers carefully read the stipulations as regards output and overload. The temperature rise test is to be made when the normal current output is a maximum, and the terminal volts at 480 volts.

The bonus and penalty clause as to steam consumption is very stringent, 26 lbs. per kilowatt-hour at full load working, condensing with 24-in. vacuum and 150 lbs. per square inch steam pressure. Penalty to be paid by contractor on all excess over 26 lbs., and bonus at corresponding rate to be paid to contractor for any reduction on 25 lbs. per kilowatt-hour. The average results of tests on the three sets are to be taken, and the bonus or penalty rate is to be £600 for each complete pound of steam, or *pro rata* for fractions of tenth parts of a pound. It is specified that these tests shall be made on site after erection at Mansfield, but we consider that most firms will prefer them to be made at their own works before delivery. The switchboard is of Mr. Hammond's usual design, arrangements being made for withdrawing from the circuit up to 31 cells on either side of the middle wire, and charging these by means of a motor-driven booster, the remaining cells being charged from the station bus bars.

The accumulator specification is very open; the tenderer is, however, asked to give twelve months' free maintenance, and to state a sum per annum for which he is prepared to maintain the cells to 80 *per cent. of their normal output* for a period not exceeding 14 years. The cable section is so worded that it is practically open for any maker of repute to offer his standard system. It will be well to note that while 12 months' free maintenance must be provided for in the tendered figure, in accordance with the recommendations of the Cable Makers' Association, a sum must be quoted to cover maintenance for a further period of four years. The permanent reinstatement of the pavements will be carried out by the Corporation at the expense of the contractor, a sum of *£1,000* being included in the tender for this section to cover this item.

The general conditions may be accepted without demur; there is an unlimited arbitration clause, a stipulation that recognised standard rates of wages shall be paid, and the graduated penalty clause which is peculiar to Mr. Hammond's specifications.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1901.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

11,307. "Improvements in ove head trolleys or collectors for electric tramway or railway vehicles." R. H. Wilkinson. June 3rd.

11,315. "The 'Sparkless' regulator for electric motors." D. McKay and H. Sclater. June 3.d.

11,327. "Improvements in and relating to the electrical transmission of signs or sounds." S. Musits, R. H. de S. Gyorgy, and E. Hagyi-Ristic. June 3rd. (Complete.)

11,348. "Improvements in syntonic space telegraphy." O. J. Lodge and A. Muirhead. June 3rd.

11,371. "An improved guard for the prevention of the fouling of overhead wires by a trolley or trolley arm used in the overhead rolling contact system of electric traction." F. J. Hewitt and W. G. Dunning. June 4th.

11,384. "Improvements in sash and ships' telegraph chain and in other chains of a like construction for the transmission of power or motion." J. S. Hollings. June 4th.

11,408. "Improvements in electric railways." The British Thomson-Houston Company, Limited. (S. B. Stewart, jun., United States). June 4th. (Complete.)

11,409. "Improvements in insulating supports or insulators for electric conductors." A. Anderson and J. M. Anderson. June 4th. (Complete.)

11,450, "Improvements in appliances for high tension electrical conductors for ensuring safety in case of fracture." W. H. Stewart. June 4th.

11,470. "Improvements in printing telegraphs." R. A. Fowden. June 4th. (Complete.)

11,500. "Improvements in the manufacture of chlorine and chlorides, and in the production of electric energy therewith." A. Sansone. June 5th.

11,524. "Improvements in electro-typing." G. E. B. Eyre, W. H. Spottiswoode, C. A. Spottiswoode, and I. E. Lewis. June 5th.

11,529. "Improved manufacture of electric lighting, heating and resistance bodies." W. Boehm. June 5th. (Complete.)

11,530. "Improvements in or relating to electric glow lamps or devices." W. Boehm. June 5th. (Complete)

11,537. "Improvements in electric alarm apparatus." C. A. Jensen. (C Zanotta, Italy.) June 5th. (Complete.)

11,545. "An improved method of fixing and connecting up guard wires for the protection of overhead trolley wires used for electric traction and means for automatically disconnecting the current supplied to the trolley wires." W. A. Heyes and L. O. Heyes. June 6th.

11,552. "An improved automatic self-locking guard for electric propelled cars or other vehicles." A. Hudson. June 6th.

11,582. "Improvements in the construction of electrical measuring instruments." E I. Everett and K. Edgcumbe. June 6th.

11,600. "Improvements in or relating to the formation of positive plates for electric accumulators or secondary batteries." J. J. H. Hunte. (J. Lürgen, Germany.) June 6th.

11,619. "A method of producing electrodes for electric accumulators." E W. Jungner. June 6th. (Complete.)

11,625. "Apparatus for applying plastic material to matrices more especially intended for use in applying the paste to the grids in making secondary battery elements." The Electrical Power Storage Company, Limited, and W. H. Hanson. June 6th.

11,629. "An improved lifeguard for electric tramcars." J. Bulma. June 7th.

11,640. "Improvements in trolley heads for overhead electric traction." A. E. Rooke and J. Patterson. June 7th.

11,660. "Improvements in wireless telegraphic signalling." E. Cadlty and H. Dickinson. June 7th.

11,676. "Improvements in rheostats, elements, or resistance boxes." (Date applied for under Patents, &c., Act, 1883, Sec. 103, November 9th, 1900, being date of application in United States.) T. S. Perkins. June 7th.

11,677. "Improvements in protecting devices for the coils of electrical apparatus." (Date applied for under Patents, &c., Act, 1883, Sec. 103, November 9th, 1900, being date of application in United States.) P. H. Thomas. June 7th.

11,702. "Improvements in and relating to electric accumulators." B. J. Lurgen and The D.P. Battery Company, Limited. June 7th.

11,703. "Improvements in electrical distribution boards." C. Grundy. June 7th.

11,709. "Improved construction of contact maker or current conductor for electric motors." W. L. Allcroft. June 7th.

11,730. "An improved fitting for incandescent lights specially applicable for electric incandescent lights." C. M. Stead. June 8th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester and Birmingham, price, post free, 9d. (in stamps).

1899.

18,335. "Improvements in electrodes for arc lamps." H. Bremer. Dated September 11th, 1899. Arc lamps:—Carbons, formed as flat plates or groups of rods or otherwise, so as to have large sectional area, are made with at least 5 per cent. of calcium or magnesium fluoride or bromide or other substances, to produce long arcs which shift about quietly, and with some calcined salt of potassium, sodium, or boron to prevent flickering. They may also be heated to redness and dipped in a fused salt of boron, a glassy coating being thus obtained to absorb the residual slag of the carbons. 2 claims.

18,350. "Improvements in or relating to electrolytes." Q. Marino. Dated September 11th, 1899. Electrolytes, which are slightly acid or alkaline, are very constant, and not liable to decomposition, are formed by the use of the carbonates of the metal, such as zinc, aluminium or lead, to be deposited. The metallic carbonate is formed by neutralising a solution of the chloride, sulphate, nitrate or acetate of the metal with one half its carbonate. The precipitated carbonate is washed and filtered. The electrolyte is formed by dissolving this carbonate in the bath liquid, such as water or glycerine, and adding thereto an organic acid, a cyanide, a ferro-cyanide, a cyanate, carbonic acid, or boric acid, and ammonium or potassium chloride, or caustic soda or potash. 1 claim.

18,365. "Improvements in central battery telephone exchange systems." W. Aitken. Dated September 12th, 1899. Relates to a central-battery telephone system in which clearing-out signal lamps are arranged for each subscriber in the plug circuits, such plug circuits being metallic without the intervention of transformers, &c. The figure shows two subscribers connected to an exchange by metallic circuits, the bells being arranged on one line with an earth return. Calling or calling and control lamp signals are shown at the exchange, and are operated by taking the telephone off the hook. The operator's apparatus consists of the ordinary listening-in and calling keys attached to two plugs, of which parts are cross-connected through two relays arranged in series, and having between them a connection to one pole of the earthed battery. These relays have double armatures, some of which control the clearing-out signals and others cut the battery off the line during conversation. 4 claims.

18,414. "Improvements in or relating to electric contacts or current-taking devices." E. Griel and E. Audiger. Dated September 12th, 1899. Means for connecting electric lamps to tables boards, &c., for decorative, advertising and other purposes. The table or other support is provided with conducting-strips of fabric or the like, insulated from one another, and covered with a cloth or like insulator. The strips are connected to the leads. The lamp or its support is fitted with pointed conductors by which contact is made with the conducting-strips through the cover. In a modified form, the table is fitted with two layers of conductors and the lamp or its support has points differing in length, one being partly covered with insulating material. 2 claims.

18,457. "Improvements in guards for electric tramcars and other tramway vehicles." J. Tidswell. Dated September 13th, 1899. Obstruction removers for electric and other tramcars. Should the hinged "feeler" meet an obstruction a pivoted catch is released and allows a bell crank to lower the spring fender close to a track. The "feeler" is reset by depressing a pedal. 1 claim.

18,468. "Improvements in electricity meters." Chamberlain & Hookham and S. H. Holden. Dated September 13th, 1899. Relates to energy and quantity meters: Motor meters are supplied with currents from thermopiles heated by main and shunt currents, and are provided with various means for obviating errors due to friction at starting, and other causes at high speeds. The current to be measured passes through a coil wound on an iron bobbin producing a vertical magnetic field. A vertical spindle geared to a counter and carrying a magnetic brake disc carries an armature disc in mercury within the iron bobbin, the space in this being closed below by a central conductor and annular insulation. The central conductor carries a bismuth block, having arms joined to antimony bars which are connected by flexible strips to the iron bobbin. The junctions on the arms are heated by coils carrying a shunt current, a constant current being thus supplied through the armature disc. In one means for correcting errors, in a continuous current meter having a conical armature immersed in mercury, through which the current to be measured passes diametrically between fixed conductors, these conductors are connected also to the ends of a thermo-couple, the joint in which is heated by a surrounding coil of wire, or by passage of the current to be measured through the thermo-couple. The coil may carry this current, or a constant shunt current to correct friction errors. In a second means for correcting errors the meter armature is connected to the ends of a bismuth shunt, the resistance of which is varied by its situation in a magnetic field, produced by the current to be measured. In a third arrangement, applicable to induction motor meters, the meter spindle carries a coil in the field of an adjustable electro-magnet. A shunt current is supplied to the coil and magnet for a short time in each revolution through a contact wire on the

spindle, and a stationary spring, to assist the rotation of the spindle at low speeds. In a fourth arrangement, a small brake, consisting of a piece of wire, is carried by an armature in a main current coil, and is applied to the ordinary brake disc or other rotating part with greater pressure as the current increases. In a fifth arrangement, the ordinary brake disc turns in the field of a brake magnet which is hung on a torsion wire so that it turns to a position of different effectiveness as the speed increases. Or the suspended brake magnet may be attached to an iron armature, which is attracted by the poles of a stationary electro-magnet carrying the main current, in opposition to the torsion of the suspension wire. 13 claims.

18,488. "Process for forming a conducting connection between electrical incandescence bodies of second-class conductors with conductors of the first-class." Siemens Bros. & Co. (Siemens & Halske Aktiengesellschaft.) Dated September 18th, 1899. Incandescent lamps:—Incandescence bodies which conduct only when hot are connected with metal wires, strips, tubes, or the like, by repeatedly coating the ends of the bodies with a suitable material and heating them to white heat, before an oxyhydrogen blowpipe or otherwise, until the ends become plastic so that the metal wires, &c., can be pushed into them. On cooling, the wires, &c., are firmly held, and the joints conduct so well that in use they do not soften. The materials applicable are silicon, boron, and refractory metals such as manganese, molybdenum, chromium, titanium, nickel, and the platinum metals and alloys; solid oxygen-free compounds of these may also be used, such as sulphides, phosphides, nitrides or carbides. The ends are coated by heating them and dipping them in the powdered material, or by applying a paste of the material mixed with water or hydrocarbons. 1 claim.

18,502. "Improvements in safety devices for electrically-operated hoisting apparatus." H. von Kramer. Dated September 18th, 1899. Relates to a device for preventing the descent of a load simultaneously under gravity and by the action of the motor. Positive lowering is effected by moving a lever over to its extreme position to the left. Should a load, however, be suspended, it starts the motor as a dynamo, and the current passing through a solenoid lowers a bolt into the path of a projecting arm on the lever. Under these circumstances the lever cannot be thrown over into the position for positive lowering. 8 claims.

18,547. "Improvements in continuous current electric motors or generators of enclosed type." H. W. Wilson. Dated September 14th, 1899. A two-pole continuous current motor or generator of the enclosed type is built up of a principal casting, having approximately the form of a square box with curved or flat sides and well-rounded corners, and a hollow cylindrical projecting part at the commutator end. This casting forms the magnet yoke, and is formed on opposite sides with openings large enough to receive the detachable hollow field-magnet cores carrying their magnetising coils. Slots are formed in the pole-faces to afford ventilation. End openings are provided in the casting large enough to permit of the passage of the armature. Ventilating openings may also be formed in the bearing flanges. 3 claims.

18,550. "Improvements in armoured insulating conduits and the method of treating same." A. G. Brookes. (A. M. Louger.) Dated September 14th, 1899. Metal tubes are provided with an electrically-insulating lining. The insulating material, preferably consisting of a mixture of vegetable oil, zinc or lead oxides, sulphur, &c., fibrous material, waste rubber, filling materials such as chalk, &c., and adhesive such as asphalt, tar resin, gums, tuna gum or balata to take the place of rubber is laid on one surface of a sheet of paper or other light fabric. The fabric is first coated with an adhesive cement such as a mixture of mineral oil, vegetable oil, asphalt with or without paraffin wax, soap, tar or gums such as tuna, balata, &c. The sheet is divided into strips of the required width, and the paper, &c., backing is removed along one edge. The strip is bent round and is inserted into the tube by means of a rod, &c. The lining is then expanded to fit tightly against the tube by means of compressed air or live steam injected by means of a nozzle fitting one end of the tube. The paper, &c., backing is then stripped off by means of a rod to which one end of the bare backing is attached, the insulating lining being left in close contact with the inner face of the tube. 16 claims.

18,555. "Improvements in splicing ears and terminals for overhead electric trolley-wires employed on electric tramways." J. Slack. Dated September 14th, 1899. Relates to electric railways and tramways with overhead conductors. The trolley-wire is held in grooves in the fast and loose wings of the splicing ear, and its free end is turned down and secured by bending the lungs over it, or the end is wrapped round the spiral grooves in a lug. The two wings are secured together to clamp the wire by rivets, screws, &c. The end of the wire is held in the wedge-shaped hole in a terminal piece by a grooved wedge, and holes in the terminal are provided for the supporting wires. 3 claims.

18,643. "Improvements relating to the amalgamation and coating of metals or alloys of metals with metals or alloys of metals by the aid of electricity and to apparatus therefor." F. Foss. Dated September 15th, 1899. Plating by movable pad, brush, and like electrodes. As described in Specification No. 25,360, A.D. 1896, plating is done by a brush or the like, supplied with a solution of any desired metal or alloy, and connected with the positive pole of an electric generator, which is kept moving over the article to be coated. In the present case, the movement is rotary so as to be much more rapid, or in some cases the article to be coated is rotated and the plating brush, &c. is stationary. Wire, metal tape, tubes, rods, bars, and other articles may be coated by this method. In one example a handle having a removable part adjustably connected thereto supports a cylinder which is rotated by a pulley and a band, and is continuously charged with a suitable electrolyte through a hollow shaft. The cylinder is provided with bristles or brushes and is perforated. It is connected by a wire and brush to the positive pole, while the article to be plated is connected to the negative lead of a source of electricity. The cylinder ends are connected by bars having sheaths of insulating material. The current is at first of high voltage, say, of 75 to 100 volts, but subsequently it is lowered to, say, 20 volts, while the current density is greatly increased. The brush cylinder may be protected by a guard on the side not facing the work. Instead of bristles, felt or other absorbent material may be used; or steel or other wire may be used, in which case the wire serves to clear the surface of the article to be treated, or, finally, asbestos, glass, slag, or mineral wool fibres may be used. In a modification, the brushes are arranged in the end, instead of in the periphery, of a rotating cylinder which turns on its vertical axis. For plating tubes, ported on a semi-circular or like stationary cathode, while the tube is mechanically rotating. For plating wire, metal rods, tape, &c., the article is drawn through a casing provided with stuffing-boxes, and with an internal rotating anode having brushes projecting inwardly. The wire, &c., may be drawn or forced through dies to smooth and polish it, or between wire brushes, before it enters the electrolyte. For plating metal sheets, flat brush anodes may be used, the sheets being mounted on a reciprocating table similar to a planing machine. The brushes may be mounted upon an insulating support parallel to and at a short distance from the anode. 11 claims.

18,664. "Improvements in, and relating to, electric railways on closed conduit systems." W. B. Purvis. Dated September 15th, 1899. Electric railways and tramways on a closed-conduit system. Conduits, conductors, collectors:—The conductor is flexible and consists of an iron core encased with copper. It lies in a closed conduit, and is lifted into contact with the metallic top by a magnet on the vehicle. This magnet is provided with fine and thick wire coils and can be excited by the main current or by a battery. Its pole carries rollers which run on the conduit, and it is supported in brackets, being normally pressed down by springs. The conduit consists of hollow blocks of metal insulated from each other by intermediate blocks and ⌐¬-pieces, the latter bearing ⌐¬-shaped metal straps, and the whole being connected together by insulated bolts, or round tubes, thinned down at their ends to fit on intermediate insulating lengths, may be used. The pipes rest on a metal support on stringers on the sleepers. The conductor is uninsulated by the channel-shaped wood, &c., insulation. Electric locomotives and motor vehicles. —The vehicle carries a battery which may be used for exciting the magnet referred to above in a case of need for picking up the conductor, and is charged from the line. For these purposes two switches are placed at each end of the vehicle, and the connections are such, that one switch of each pair will make the battery circuit through the coil, and the other will complete the circuit from the collector through the battery to the motor casing and wheels, and so to earth for charging it. 11 claims.

18,754. "Improvements in galvanic batteries." P. Meyer. Dated September 16th, 1899. Relates to a dry battery. It is made up of a cell or casing, a zinc electrode, a carbon electrode which has packed around it a depolarising mixture and an electrolyte which is absorbed in turf wool. A piece of linen which serves as a porous vessel is wrapped around the depolariser. The cell is closed by a layer of plaster mixed up with the exciting liquid, and by a layer of pitch, or wax. The depolariser is a mixture of manganese peroxide or a manganese salt, graphite, and a metallic chloride. The exciting liquid is a mixture of ammonium chloride and a metallic chloride. 1 claim.

18,759. "Improvements in disconnecting boxes for electric cables." C. C. Fowler and Reason Manufacturing Company. Dated September 18th, 1899. Junction boxes for concentric and other electric mains are provided with short lengths of cable extending outward for connection to the mains. The inner ends of the mains are connected to plug sockets mounted on an insulating-base, and projecting through an insulating cover-plate. Insulated spiders are provided with plug sockets corresponding to the cable sockets. The plugs are arranged in pairs, and may be provided with fuses which pass over insulating-ridges. A cover-plate may be screwed or clamped over the box. 2 claims.

18,776. "A new or improved arrangement of driving mechanism for connecting electric motors to machinery." G. J. Gibbs. Dated September 18th, 1899. Motors, gearing for:—The mechanism for connecting the motor with the driven machine is arranged so that the motor can be relieved at starting, and the driven machine readily stopped when required. In the arrangement shown, the motor shaft carries a pinion, which drives a spur-wheel on a countershaft, the latter in turn driving the shaft of the machine through belt-and-pulley gearing. The countershaft is mounted in bracket, pivoted to a standard and capable of being operated by a rod, so as to slacken the belt. Alternatively, the motor may drive the countershaft through belt-and-pulley gearing, the countershaft being connected to the machine through toothed gearing. In this case, the countershaft is suspended from the shaft of the driven machine. 2 claims.

18,870. "Improved manufacture of electrical insulating material." A. J. Boult. (Jangbluth, J.) Dated September 19th, 1899. Insulating compositions for conduits for electric conductors, &c., are formed of a mixture of powdered calcium carbonate, Trinidad asphalt neutralite, or other similar bituminous material, and a small proportion of selenite. The materials are melted together until homogeneous. 2 claims.

18,882. "Improvements in electrical 'damping' apparatus." G. W. Johnson. (Hartmann and Braun.) Dated September 19th 1899. In an electro-magnetic brake, consisting of a conducting disc revolving in the fields of stationary magnets the total retardation is rendered proportional to the velocity of the disc by pivoting one magnet so that it can turn in opposition to a spring and thus act at varying distances from the axis of the disc. The magnet retardation at first increases as the magnet poles move away from the axis, but afterwards diminishes as they approach the edge of the disc: friction at low speeds and air resistance at high speeds are thus compensated for. The effect may be increased by providing radial tapering slots in the disc, or making it of varying thickness. The position of the pivoted magnet is indicated by a pointer on a scale, graduated to show velocities, or watts or amperes when the brake is used in an electricity meter. The invention is applicable to any eddy-current brake having a conducting body and magnets movable relatively to one another. 2 claims.

18,904. "Improvements in the method of and means for preventing electric sparking at contacts in circuits, including electro-magnet coils or other coils or conductors, in which a self-inductive or sparking capacity exists." W. L. Wise. (C. L. Buckingham.) Dated September 19th, 1899. Relates to the winding of electro-magnets or solenoids to prevent sparking at the terminals when the circuit is broken. The specification describes different arrangements. In one the core has two windings. In another there are four windings. In a further one the windings are arranged in groups cross-connected. 2 claims.

18,962. "Improvements in telephone registering apparatus." O. Linck-Graf and Gmuer-Benz. Dated September 20th, 1899. Relates to apparatus for controlling the action of the time mechanism in telephonic apparatus when combined with registering devices. The magnetic actuating spindle is provided with a worm connected by gearing with a spring drum, part of the circumference of which is removed to prevent over-winding. Two trains of movements are employed, one for the fan and one for the registering device, the latter being controlled by the pendulum, the armature of the electro-magnet acts on one of the arms of a forked lever. The various levers so interact that a call sent from one subscriber liberates one part of that subscriber's apparatus, and locks his pendulum, the calling subscriber's apparatus being released, and the registering apparatus started by a current sent when both telephones have been taken off their hooks. The registering mechanism is not stopped until the clearing-out signal is sent. 2 claims.

18,968. "Improvements in, and relating to, electric incandescent lamps." W. P. Thompson. (E. Linding-Larsen.) Dated September 20th, 1899. Incandescent lamps. A carbon or other filament is mounted in an exhaust U-tube, in the ends of which the leading-in wires are sealed, and which contains a drop of mercury. Current is at first supplied to the lamp through a resistance, or lamps are at first connected in series instead of parallel, until the mercury volatilises. Instead of using mercury, the lamp may contain argon, nitrogen, or other indifferent gas, under considerable pressure, which may be four atmospheres, when the lamp is in action. It is stated that filaments can be heated to a very high temperature in such atmospheres without volatilisation. 2 claims.

18,980. "Improvements in telegraphic apparatus." A. C. Crehore, and O. G. Squier. Dated September 29th, 1899. Relates to improvements applicable to use with the apparatus described in Specifications No. 21,630 and 23,687 A.D. 1893, No. 23,556, A.D., 1898, and No. 4,931, A.D. 1899. The provisional specification also refers to Specification No. 6,787, A.D. 1897. When two or more impulses of the same sign are sent to line in series, the electromotive force of the generator is reduced, by an impedence coil, shunt, resistance coil, counter electromotive force, electrostatic capacity, the combination of two or more of the above, or by breaking the generator circuit either between the generator and transmitter, or between the transmitter and line. The specification describes how an impedance coil, &c., is inserted in the generator circuit and comprises the ordinary + and − brushes in circuit with magnets for putting either pole to the generator to line or earth, and also additional pilot brushes, which close the local circuits of magnets when two or more impulses of the same sign come in immediate succession. The latter magnets attract the armature introducing the impedance, &c., into the generator circuit. When levers instead of contact brushes are employed, the action of both pilot and ordinary lever simultaneously closes the local circuit, inserting the impedance, &c., in the generator circuit. The armature may close a shunt across the generator, or may open the generator or line circuit. 2 claims.

19,020. "Improvements in electric arc lamps." T. Wilby. Dated September 21st, 1899. Relates to arc lamps. A stationary dash-pot is provided with a piston and a rod constructed to permit free downward movement of the rod and a solenoid core attached to it. The rod passes freely through the piston, and has a spherical projection and an end lip limiting its motion therein. An axial hole in the end of the rod opens laterally between the projection and lip, so that air is admitted to the interior when the rod moves downward; but when the rod is raised, the spherical projection closes the opening in the piston. The dash-pot is applicable to a clutch lamp adapted to receive a long upper carbon, which is inserted in a short tube having tongues formed by slitting its ends, and bent in and out to slide in and connect the carbon with a surrounding tube. This tube and a clutch ring are carried by the tubular core of a series solenoid, and carry the piston rod of the dash-pot. The surrounding tube slides in a guide. A resistance and switch are provided. 4 claims.

19,384. "Improvements in or connected with electric clock systems." J. G. Lorrain, M.I.E.E., M.I.M.E. (H. A. Macdonald.) Dated September 26th, 1899. Electro-magnetic waves affecting a relay are emitted from the master clock to close the circuit of the synchronising electro-magnet or the winding motor of a secondary clock. The attraction of the armature of a synchronising electro-magnet is controlled by a dash-pot so as to prevent operation by chance transient currents due to accidental contact or induction of other systems. The operation by waves from other sources than the master clock is rendered impossible by the employment of a mechanical circuit-closer in the secondary clock. 11 claims.